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VOLUME 1 NUMBER 5

Scientific and Technical Aerospace Reports

A Semimonthly Publication
of the National Aeronautics and Space Administration

March 8, 1963

01 GENERAL

Includes: management; space law and legal matters; symposia or conferences of a broad or a general nature.

N63-12019 Joint Publications Research Service, Washington, D.C.
WORKS SUBMITTED IN COMPETITION FOR THE 1963 LENIN PRIZES
Jan. 23, 1963 37 p 132 refs Transl. of an announcement by the Comm. on Lenin Prizes in the Field of Sci. and Technol., Council of Ministers USSR in Izv. (Moscow), Dec. 4, 1962 p 3-4
(JPRS-17261) OTS: $3.60

Works submitted in competition for the 1963 Lenin Prizes in the fields of science and technology included those in the following areas: (1) physical mathematics, (2) chemistry, (3) geology and geography, (4) biology and agriculture, (5) historical sciences, (6) economics and philosophy, (7) machine building, (8) instrument making and automation facilities, (9) metallurgy, (10) mineral mining and prospecting, (11) power engineering, (12) medicine, (13) chemical technology, (14) construction and architecture, (15) agriculture and lumber industry, (16) food and light industries, and (17) medical sciences. I.v.L.

N63-12138 National Aeronautics and Space Administration, Washington, D.C.
STATEMENT [ON AERONAUTICAL RESEARCH PROGRAM] BEFORE THE SUBCOMMITTEE NO. 2, COMMITTEE ON SCIENCE AND ASTRONAUTICS, HOUSE OF REPRESENTATIVES
John Stack Oct. 19, 1962 29 p
OTS: $2.60 ph, $1.07 mf

A statement describing NASA's aeronautical research program to Congress is presented. The major areas of this research include: (1) increasing the economy and all-weather operation of low-speed helicopters, (2) developing a supersonic transport aircraft for economical operation out of existing airports, (3) developing a S/TOL vehicle for shorter ranges and smaller airports, (4) investigating multimission aircraft for military requirements, and (5) pursuing laboratory and flight tests of hypersonic flight, especially with the X-15. M.P.G.

N63-12291 Congress. House. Committee on Science and Astronautics
RADIO AND RADAR ASTRONOMY Report of the Committee on Science and Astronautics, U. S. House of Representatives, Serial AA
Earl G. Peacock and Joseph M. Felton Washington, GPO, 1963 34 p 6 refs
(87th Cong. 2nd Sess. Committee Print)

Emphasized in this report are: (1) the Sugar Grove Facility; (2) radio frequency allocations to radio astronomy on a primary basis; and (3) the proposal of a solar observatory within the National Bureau of Standards. I.v.L.

N63-12292 Congress. House. Committee on Science and Astronautics
WAYS AND MEANS OF EFFECTING ECONOMIES IN THE NATIONAL SPACE PROGRAM Report of the Committee on Science and Astronautics, U. S. House of Representatives, Serial Y
Washington, GPO, 1963 22 p
(87th Cong. 2nd Sess. Committee Print)

Cost-saving possibilities in the national space program are discussed. Short-term measures described include: (1) reliability, simplicity, standardization and utilization of equipment and facilities; and (2) management policies. Long-range proposals discussed include: sea-launched boosters, manned recoverable vehicles, orbital basing concept, and technological advances. I.v.L.

N63-12293 Congress. House. Committee on Science and Astronautics
DEVELOPMENT OF LARGE SOLID PROPELLANT BOOSTERS Report of the Committee on Science and Astronautics, U. S. House of Representatives, Serial Z
Joseph M. Felton and Earl G. Peacock Washington, GPO, 1962 18 p
(87th Cong. 2nd Sess. Committee Print)

The program for the development of large solid propellant boosters as a backup or parallel approach to the liquid booster is reviewed. I.v.L.

N63-12294 Air U. Research Studies Inst., Maxwell AFB, Ala.
AN AEROSPACE BIBLIOGRAPHY [COVERING PERIOD THROUGH JAN. 1962]
Raymond Estep Sept. 1962 61 p 3100 refs
(AU-290-61-RSI)

This volume combines annotated bibliographies of materials covering air power and space sciences, that are available at the Air University Library. Subject and author indexes are included. R.C.M.

N63-12343 Library of Congress. General Reference and Bibliography Div., Washington, D. C.
WORLD LIST OF FUTURE INTERNATIONAL MEETINGS. PART I: SCIENCE, TECHNOLOGY, AGRICULTURE, MEDICINE New Meetings and Changes, February 1963-January 1966
Washington, GPO, Feb. 1963 45 p
GPO: Annual Subscription, $3.75

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes: aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc.

For related information see: 03 Aerodynamics of Wings, Rotors and Control Surfaces; and 11 Fluid Mechanics.

N63-12001 Aeronautical Research Inst. of Sweden, Stockholm

AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF SECOND-ORDER WING-BODY INTERFERENCE AT HIGH MACH NUMBER Technical Note No. 6

Peter G. Wilby Aug. 1962 15 p 5 refs
(Contract AF 61(052)-75)
(FFA-91)

The second-order wing-body interference theory of Landahl and Beane is used in the theoretical calculation of the pressure distributions over the wing of a wing-body combination. Results are compared with experimental values obtained from wind-tunnel tests, at a Mach number of 7.35, on a cone-cylinder nonlifting body with a triangular wing of wedge section set at incidences of 0°, 3°, 6° and 10°. It is shown that interference effects can be very large and can be calculated theoretically with good accuracy. Author

N63-12002 Bell Helicopter Co., Fort Worth, Tex.

INVESTIGATION OF CONTROLLED FLOW PHENOMENA FOR AIR CUSHION VEHICLES

Kenneth G. Wernicke, Rodney K. Wernicke, et al Ft. Eustis, Va., Army Transportation Research Command, Nov. 1962 136 p 7 refs
(Contract DA 44-177-TC-744)
(Rept. 532-099-001; TCREC-TR-62-46)

This report presents the results of an analytical and experimental model investigation of controlled flow configured air cushion vehicles. Controlled flow is defined as the flow pattern which exists when a peripheral jet is established without the use of internal ducting or a base plate. Main objectives of the investigation included achieving a practical approximation to ideal controlled flow which depends heavily on the Coanda phenomenon, then comparing the characteristics of controlled flow versions with conventional forms of the plenum and peripheral jet. Criteria for evaluating the relative merits of controlled flow include considerations of stability, controllability, and integrated propulsion system characteristics as well as performance in hovering flight. Thirty variations in planform and internal arrangements are discussed. The findings indicate that on a performance basis controlled flow configurations outperform base plate peripheral jet configurations. In addition, improvements in stability characteristics over the base plate peripheral jet configuration were also achieved, and potential for further optimization was indicated. Controlled flow techniques applied to external flow air cushion vehicles were briefly explored. Author

N63-12093 Aeronautical Research Council (Gt. Brit.)

FLOW FIELD AND PRESSURE DISTRIBUTION MEASUREMENTS ON BLUNT-NOSE BODIES AT M = 6.8. PART I. MEASUREMENT OF THE SONIC LINE, BOW SHOCK WAVE SHAPE AND STAND-OFF DISTANCE FOR BLUNT-NOSED BODIES AT M = 6.8. PART II. PRESSURE MEASUREMENTS ON TWO BLUNT-NOSED BODIES AT M = 6.8

W. K. Osborne and J. F. W. Crane London, HMSO, 1962 29 p 11 refs
(ARC-CP-615; previously issued as RAE-TN-AERO-2707, RAE-TN-AERO-2766, ARC-22372, and ARC-23437) Available from HMSO: 5s.

This report describes the experimental measurement of sonic points between the bow shock waves and surfaces of three blunt-nosed bodies: a hemisphere, an ellipsoid, and a hyperboloid. A comparison between these measurements and the theoretical sonic lines calculated by Mangler shows reasonable agreement. Comparisons between the theoretical and the experimental bow shock wave shapes for these body configurations, together with their stand-off distances from the bodies, show very close agreement. Pressure distribution measurements along the surfaces of the ellipsoid and hyperboloid are described. On the forward part of the bodies a comparison between the experimental pressure distribution and the theoretical pressure distribution calculated by Mangler shows good agreement. However, agreement becomes progressively worse downstream. The experimental pressure distributions compare fairly well with the modified Newtonian pressure distributions for the two bodies. The location of the sonic points on the surfaces of the bodies, deduced from the experimental pressure distribution, gives values which are compatible with the sonic point measurements. Author

N63-12191 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

PERFORMANCE OF A TURBOJET ENGINE IN COMBINATION WITH AN EXTERNAL-INTERNAL-COMPRESSION INLET TO MACH 2.88

David N. Bowditch, Bernard H. Anderson, and William K. Tabata Washington, NASA, July 1960 30 p 16 refs
(NASA TM X-254) OTS: $0.75

A turbojet engine was operated in conjunction with an inlet having external and internal supersonic compression in the Lewis 10- by 10-foot wind tunnel at several Mach numbers from 2.0 to 2.88. The presence of the engine had no effect on the steady-state peak inlet performance. Even though distortions higher than 30 percent of the average total pressure were measured at the compressor face, no engine stall was encountered during steady-state operation, and there was no significant reduction in engine performance. However, when the shock regurgitation or unstart transient pressure drop was large enough, as it was at Mach 2.48 and above, the engine surged. During engine surge at Mach 2.48, the static pressure near the engine face reached a value 17 percent higher than the free-stream total pressure. At Mach 2.68 and 2.88, however, maximum static pressures during surge were less than the peak pressure due to buzz. Author

N63-12287 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL AND THEORETICAL STUDIES OF THE EFFECTS OF CAMBER AND TWIST ON THE AERODYNAMIC CHARACTERISTICS OF PARAWINGS HAVING NOMINAL ASPECT RATIOS OF 3 AND 6

Edward C. Polhamus and Rodger L. Naeseth Washington, NASA, Jan. 1963 37 p 15 refs
(NASA TN D-972) OTS: $1.00

Low-speed wind-tunnel studies were made of the effects of camber and twist and the effects of aspect ratio on the aerodynamic characteristics of parawings. To determine the effects of camber and twist, tests were made both with the conventional conical-type canopy, which provides camber and washout, and with a cylindrical-type canopy which provides essentially zero camber and twist. With regard to aspect ratio, tests were made of parawings having aspect ratios of 3 and 6; the range was thereby extended well beyond that of previous investigations. The degree to which airfoil and wing theory can be used to predict the aerodynamic characteristics of parawings was also investigated. Results indicated that improvements in lift-drag ratio can be obtained both by the use of the cylindrical canopy and by the use of a high-aspect-ratio canopy. The aspect-ratio-6 cylindrical parawing provided a maximum lift-drag ratio of approximately 13.6. The results also indicated that, for

conical type canopies, improvements in the zero-lift pitching-moment characteristics could be obtained by use of the higher aspect ratio. With regard to theory, the results indicated that sufficient accuracy for preliminary design can be obtained by use of the Pankhurst method for camber effects and the Weissinger method for angle-of-attack and twist effects. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes: ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N63-12128 Aeronautical Research Council (Gt. Brit.)

MEASUREMENT OF THE PITCHING-MOMENT DERIVATIVES FOR RIGID TAPERED WINGS OF HEXAGONAL PLANFORM OSCILLATING IN SUPERSONIC FLOW

L. Woodgate, J. F. M. Maybrey, and C. Scruton London, HMSO, 1962 33 p 3 refs

(ARC-R&M-3294; previously issued as ARC-22683) Available from HMSO: 13s.

Results are given for the pitching-moment derivatives of tapered wings with streamwise and raked tips. Three aspect ratios and three pitching-axis positions were tested. The influence of a body with two alternative nose shapes was also investigated. The results were in better agreement with theory when allowances were made for the finite thickness of the wing. Author

04 AIRCRAFT

Includes: specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; stability and control.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N63-12031 General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio

LIFT FAN FLIGHT RESEARCH AIRCRAFT PROGRAM (VZ-11) Quarterly Technical Progress Report No. 4, August 18, 1962 to December 14, 1962

Dec. 31, 1962 190 p

(Contract DA 44-177-TC-715)

Heat transfer system design was altered to incorporate recent data and configuration review changes. Study of wing fan door actuation system continued, as did design of a pitch fan diverter valve. Testing of the RPM indicating and limiting system was completed. Weight and reliability analysis of hardware continued. Firings of ejection seat are still underway with another canopy shot to come. Flightworthiness tests were completed. One-sixth scale fan-powered tests are complete. Aileron droop system has been incorporated to improve conversion characteristics. Canopy windshield lines have been altered for better visibility. Aileron boost system has been incorporated into controls design. Fabrication of aircraft parts is progressing, with more than 1200 parts complete. Major assembly tooling is 92 percent complete. All major aircraft equipment items are on order. Author

N63-12051 Maryland U., College Park

EXPERIMENTAL STUDIES OF THE AERODYNAMICS OF GROUND EFFECT MACHINES [Report for Period July 1961-June 1962]

Donald S. Gross and Jerrold V. Powers, Jr. Ft. Eustis, Va., Army Transportation Research Command, Nov. 1962 208 p 5 refs

(Contract DA 44-177-TC-776)

(TCREC-TR-62-88)

The aerodynamics of the Tinajero ground-effect machine and its two-dimensional counterpart were investigated under various flight conditions. Tests of the full-scale machine included external aerodynamics, control effectiveness, stability, and the effect of changing the vertical center of gravity. Tests were conducted in the University of Maryland Subsonic Wind Tunnel diffuser section and on a ground board set up in the open air. The machine was found to be basically unstable in yaw, and the controls were ineffective. The two-dimensional model, with several nose shapes, was tested in a twenty-four-inch subsonic wind tunnel to obtain the flow patterns and pressure distributions. It was found that nose shape had no real effect on the cushion under the vehicle, but did affect the basic external aerodynamic coefficients. Significant changes in flow patterns were observed as forward speed increased. Author

N63-12175 Federal Aviation Agency. Systems Research and Development Service, Washington, D.C.

DESIGN FOR THE NATIONAL AIRSPACE UTILIZATION SYSTEM First Edition [Status Report]

Albert Brown June 30, 1962 738 p 56 refs

The safe and efficient passage of air vehicles is discussed with emphasis on the system aspects of airspace utilization and on the specification of a system design which can be implemented. An amplification of the phrase "airspace utilization system" is given. A comprehensive forecast of traffic patterns through 1975 is discussed, as to type of traffic and its distribution in time, geography, and altitude. Problems of using the electromagnetic spectrum and the possibilities of interference by other signals utilizing the airspace are considered. A.R.B.

N63-12192 National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

SOME OPERATIONAL ASPECTS OF USING A HIGH-PERFORMANCE AIRPLANE AS A FIRST-STAGE BOOSTER FOR AIR-LAUNCHING SOLID-FUEL SOUNDING ROCKETS

Victor W. Horton and Wesley E. Messing Washington, NASA, Jan. 1963 23 p 3 refs

(NASA TN D-1279) OTS: $0.75

Five test vehicles were air-launched from an F-104A airplane to investigate some of the operational aspects and the practicability of using the energy input of the airplane as a first-stage booster for sounding rockets. A launch maneuver and launcher system were developed and matched to the airplane's capabilities so that suitable repeatability of launch parameters was attained. Author

N63-12241 Garrett Corp. AiResearch Mfg. Div., Phoenix, Ariz.

GEM CONTROL SYSTEM STUDY Progress Report [Nov. 1961-Nov. 1962]

B. W. Anderson, R. V. Boyle, and O. A. Becker Dec. 7, 1962 272 p

(Contract NONr-3173)

(AP-5061-R)

A complete analytical formulation has been established for a typical ground effects machine which is fully controllable in 6 degrees of freedom. Motion equations were derived for pitch, roll, heave, yaw, forward flight, and side slip. The forces and moments due to wind acting on these motions are described, and a representation of the water dynamics beneath the vehicle was developed. A preliminary design of a suitable control system was established, based on vehicle and engine dynamics. A piloted control simulator was constructed, and the effects of control command inputs and display parameters were investigated on the analog control computer. M.P.G.

N63-12243 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SPIN INVESTIGATION OF A 1/20-SCALE MODEL OF AN UNSWEPT-WING, TWIN-ENGINE, OBSERVATION AIRPLANE

Henry A. Lee Washington, NASA, Jan. 1963 19 p 4 refs
(NASA TN D-1516) OTS: $0.50

The effects of control settings and movements on the erect spin and recovery characteristics for the normal loading and the most rearward center-of-gravity loading (external wing tanks full) were determined. Also, tests were made to determine the effect on the spin and recovery characteristics of a large radar store, of empty and full external wing tanks, and of an asymmetrical condition when one empty or one full external wing tank is carried. Spin-recovery parachute tests were also performed. Author

N63-12247 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HANDLING QUALITIES AND OPERATIONAL PROBLEMS OF A LARGE FOUR-PROPELLER STOL TRANSPORT AIRPLANE

Hervey C. Quigley and Robert C. Innis Washington, NASA, Jan. 1963 48 p 12 refs
(NASA TN D-1647) OTS: $1.25

A flight investigation has shown that a 100,000-pound transport airplane equipped with blowing boundary-layer control on highly deflected flaps, drooped ailerons, and control surfaces can take off and land over a 50-foot obstacle in less than 1,500 feet and at speeds of less than 65 knots. It is indicated that some standard operational techniques and procedures should be changed for STOL operation. The airplane had satisfactory longitudinal and unsatisfactory lateral-directional handling qualities. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes: celestial mechanics; and radioastronomy.

For related information see: 12 Geophysics; and 29 Space Sciences.

N63-12041 Boston U., Mass.

THE PLATE CONSTANTS OF MOON PHOTOGRAPHS Research Report No. 2

Badri Aghassi Sept. 1962 12 p 3 refs
(NASA Grant NsG 246-62)
(*Its* Astronomical Contributions, Ser. II, No. 18) OTS: $1.60 ph, $0.80 mf

A computational method for obtaining the selenographic coordinates of points on a fragment of a photograph of the moon, without translating and rotating the systems of axes to fit Saunder's concentric solution, is presented. In this method, the loci of constant ξ, η, and ζ are considered as three families of parallel coaxial circles. Since in an orthographic projection these circles project as three families of elipses of the same ellipticity, an equation of conics can be written which fits ξ and η as polynomial functions of the vectors x and y. A correction for the deformation caused by the conic projection is given, although this is considered to be negligible. Results were computed for the coordinates of the center of the disc and for the scale and inclination of the photograph. M.P.G.

N63-12043 New Mexico U. Engineering Experiment Station, Albuquerque

LUNAR SURFACE CHARACTERISTICS BASED ON RADAR AND PHOTOGRAPHIC DATA Semi-Annual Progress Report

Donald H. Lenhert, W. W. Koepsel, Richard Bechtel, Nasir Ahmed, and Frank Janza Oct. 1962 38 p refs
(NASA Grant NsG-129-61)
(PR-39) OTS: $3.60 ph, $1.34 mf

Lunar surface characteristics based on radar and photographic data include the following investigations: (1) correlation of radar and photographic data with major emphasis upon the use of the reflected radar pulse envelope and a photograph of the area of return to determine possible correlation between radar scattering and light scattering from a given terrain; and (2) variations and effect of R^{-n} Fresnel zone transitions in the estimation of lunar surface roughness. To avoid the problems occurring at microwave frequencies, data were taken using an acoustic radar simulator. Results indicate that the power return varies as R^{-4} when the excitation phase is less than $\lambda/4$ across the reflector. An R^{-3} power return occurs when the phase difference is between $\lambda/2$ and $\lambda/4$ and finally an R^{-2} power return occurs for phase difference greater than $\lambda/4$ across the plate. I.v.L.

N63-12059 Stanford U. Microwave Lab., Calif.

REVIEW OF THE INTERACTION BETWEEN THE GEOMAGNETIC FIELD AND THE SOLAR CORPUSCULAR RADIATION

R. Blum Nov. 1962 75 p 132 refs
(Contract AF 49(638)-342)
(ML-975)

The interaction between geomagnetic field and solar corpuscular radiation is reviewed with particular emphasis on the theoretical quantitative aspects. I.v.L.

N63-12071 Boston U., Mass.

IMPACTS ON THE EARTH AND MOON Research Report No. 3

Gerald S. Hawkins Nov. 1962 7 p
(NASA Grant NsG-3246-62)
(*Its* Astronomical Contributions, Ser. II, No. 20) OTS: $1.10 ph, $0.80 mf

A study has been made of statistics of the number and size of meteoritic impacts on the surface of the earth. The statistics studied also indicated whether the meteorite was stone or iron. From these statistics, equations were derived by assuming that 1/10 of a stone and 1/5 of an iron is recovered. It may be assumed from this study that the impact rates for the surface of the moon are one-half the impact rates for the earth when allowance is made for the effect of concentration caused by the earth's gravitational field. Tables are appended which show the cumulative number of impacts on the moon during 3×10^9 years. The tables are arranged to show the mass, stone meteorites, iron meteorites, asteroids, comets, and combined stones and irons in impacts. A.S.

N63-12074 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ON LAGRANGE'S THEORY OF THE THREE-BODY PROBLEM

Karl Stumpff Washington, NASA, Jan. 1963 15 p 3 refs
(NASA TN D-1417) OTS: $0.50

Lagrange's famous studies of the three-body problem are redeveloped in modern mathematical expressions. This new portrayal of a very old problem of celestial mechanics gives rise to various considerations which can be very useful for the practical computation. In particular, the nine elements of the "reduced" three-body problem are defined as a symmetrically constructed system of three groups of three elements each, and their differential equations are shown. A byproduct of this study is a representation of the coefficients of the equation of the fourth degree for Lagrange's quantity ρ in symmetrical form. Author

N63-12077 Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park

SOLAR RADIO NOISE. PART II: TYPE III BURSTS

T. J. M. Boyd June 1962 32 p 56 refs

(NASA Grant NsG-220-62)

(BN-290) OTS: $3.60 ph, $1.16 mf

The main properties of type III bursts are listed, together with those of the U-bursts which are closely associated phenomena. Author

N63-12078 Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park

SOLAR RADIO NOISE. PART III: TYPE IV BURSTS

T. J. M. Boyd Aug. 1962 25 p 33 refs

(NASA Grant NsG-220-62)

(BN-291) OTS: $2.60 ph, $0.95 mf

A survey of the main results from observations of type IV solar radio noise is given, with some discussion of the interpretation of these results. Author

N63-12115 Smithsonian Astrophysical Observatory, Cambridge, Mass.

CATALOG OF PRECISELY REDUCED OBSERVATIONS, NO. P-6

Jean E. Mac Donald Sept. 10, 1962 52 p 4 refs

(NASA Grant NsG-87-60)

(SAO Special Rept.-104) OTS: $5.60 ph, $1.76 mf

Orbital data of Satellite 1961 δ1 (Explorer IX) are given for the period from launch on February 16, 1961 through June 30, 1961. The data were obtained from reduced observations by camera tracking stations. R.C.M.

N63-12116 Smithsonian Astrophysical Observatory, Cambridge, Mass.

CATALOG OF PRECISELY REDUCED OBSERVATIONS, NO. P-7

Phyllis Stern, comp. Nov. 1, 1962 40 p 3 refs

(NASA Grant NsG-87-60)

(SAO Special Rept.-106) OTS: $3.60 ph, $1.40 mf

The positions of Vanguard II (Satellite 1959 α1) and Vanguard III (Satellite 1959 η1) from January 1 through June 30, 1960, are cataloged. The positions were obtained during this period from the precise reduction of all reliable observations of these satellites by the 12 Baker-Nunn Camera Stations. M.P.G.

N63-12119 Smithsonian Astrophysical Observatory, Cambridge, Mass.

RE-ENTRY AND RECOVERY OF FRAGMENTS OF SATELLITE 1960 ι1 [SPUTNIK IV]

Charles A. Lundquist et al Dec. 21, 1962 27 p refs

(NASA Grant NsG-87-60)

(SAO Special Rept.-109) OTS: $2.60 ph, $1.01 mf

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1. SMITHSONIAN ASTROPHYSICAL OBSERVATORY PROGRAM FOR OBSERVATION, RECOVERY, AND SCIENTIFIC UTILIZATION OF SATELLITE FRAGMENTS C. A. Lundquist p 1-8 2 refs
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3. FIELD INVESTIGATION OF SPUTNIK IV SIGHTINGS AND FRAGMENT RECOVERIES W. A. Munn p 15-20
4. RADIOACTIVITIES IN THE MANITOWOC FRAGMENT D. Tilles, E. L. Fireman, and J. De Felice p 21-22

N63-12146 Harvard Coll. Observatory, Cambridge, Mass.

A Z-MODE SPACE RADIO PROGRAM Scientific Report No. 4

M. D. Papagiannis and G. R. Huguenin Aug. 1962 18 p

(Contract AF 19(604)-6120)

(AFCRL-62-1059)

In this paper we have calculated the positions of a 1000-km. circular orbit satellite, in terms of the universal time and the day of the year, from which it can see radiation from the sun propagating through the Z-mode. Author

N63-12151 Maryland U., College Park

JUPITER: CHEMICAL COMPOSITION, STRUCTURE AND ORIGIN OF A GIANT PLANET

E. J. Öpik Repr. from Icarus, v. 1, no. 3, Oct. 1962 p 200-257 49 refs

(NASA Grant NsG-58-60)

A comprehensive analysis is made of the observational and theoretical information regarding the composition, structure, and origin of Jupiter, which is viewed as a cosmogonic test case of a giant planet. With a polychromatic radiative-equilibrium temperature of 112 $\pm$ 2° K, based on the radiative properties of ammonia and methane as the chief radiators, the occultation of Aristis yields a mean molecular weight of $\mu = 4.3 \pm 0.5$ for Jupiter's atmosphere. From radiometric observations, as well as from the independent evidence of the temperature of the ammonia clouds, an internal heat supply for Jupiter is indicated of the order of 1.2×10^4 erg/cm^2 sec or 1.6 ± 0.4 times the solar input. It is shown that differentiation by condensation of solid particles, especially snowing-out of hydrogen from the nebular ring, is quantitatively adequate to achieve concentration of hydrogen in the core of a Jovian planet as well as to lead to the subsequent accretion of a helium atmosphere. The solid hydrogen-helium model of Jupiter's internal structure is shown to be the only one in harmony with observation and theory. J.R.C.

N63-12201 Joint Publications Research Service, Washington, D.C.

SOVIET ASTRONOMICAL REPORTS

Jan. 29, 1963 93 p 56 refs Transl. of 3 articles from Izv. Glavnoi Astron. Observ. (Kiev), v. 3, no. 2, 1961 p 27-67, 68-76, and 138-150

(JPRS-17363) OTS: $2.25

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1. INVESTIGATION OF THE FLICKERING OF STAR IMAGES IN TELESCOPES I. G. Kolchinskiy p 1-52 41 refs (See N63-12202 05-05)
2. BARYCENTRIC HIGH RELIEF OF THE LIMB ZONE OF THE MOON I. V. Gavrilov p 53-64 11 refs (See N63-12203 05-05)
3. THE SOLAR DIFFRACTION SPECTROGRAPH OF THE MAIN ASTRONOMICAL OBSERVATORY OF THE ACADEMY OF SCIENCES, UKRAINIAN SSR E. A. Gurtovenko and Ye. I. Didychenko p 65-90 4 refs (See N63-12204 05-05)

N63-12202 Joint Publications Research Service, Washington, D.C.

INVESTIGATION OF THE FLICKERING OF STAR IMAGES IN TELESCOPES

I. G. Kolchinskiy *In its* Soviet Astronomical Reports Jan. 29, 1963 p 1-52 41 refs (See N63-12201 05-05) OTS: $2.25

Investigation of flickering of star images in telescopes includes: (1) distribution of deviations according to magnitude, (2) relationship between amplitude of flickering and zenith distance, and (3) amplitude of flickering at the zenith (angle of turbulence). I.v.L.

N63-12203 Joint Publications Research Service, Washington, D.C.
BARYCENTRIC HIGH RELIEF OF THE LIMB ZONE OF THE MOON
I. V. Gavrilov *In its* Soviet Astronomical Reports Jan. 29, 1963 p 53-64 11 refs (See N63-12201 05-05) OTS: $2.25

Barycentric high relief of the limb zone of the moon was investigated, using data on the lunar shape. I.v.L.

N63-12204 Joint Publications Research Service, Washington, D.C.
THE SOLAR DIFFRACTION SPECTROGRAPH OF THE MAIN ASTRONOMICAL OBSERVATORY OF THE ACADEMY OF SCIENCES, UKRAINIAN SSR
E. A. Gurtovenko and Ye. I. Didychenko *In its* Soviet Astronomical Reports Jan. 29, 1963 p 65-90 4 refs (See N63-12201 05-05) OTS: $2.25

Construction and performance evaluation of the solar diffraction spectrograph are discussed. I.v.L.

06 AUXILIARY SYSTEMS

Includes: fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters.

For primary propulsion systems see: 27 Propulsion

For related information see: 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; and 22 Navigation and Guidance.

N63-12016 Joint Publications Research Service, Washington, D. C.
MARINE SELF-EXCITING SYNCHRONOUS GENERATORS
D. V. Vilesov and I. A. Ryabinin Jan. 23, 1963 27 p Transl. from the book "Sudovyye Samovozbuzhdayushchiyesya Sinkhronnyye Generatory" Moscow, 1962 p 3-13, 159-167, 179-180
(JPRS-17252) OTS: $2.60

An evaluation is made of self-exciting synchronous generators and their use in electric power systems, particularly the power systems of ships. The various components of the generators are discussed. Tests of the generators under shipboard conditions have shown: (1) The dynamic characteristics are improved, and the starting of asynchronous short-circuited electric motors, with a power comparable to the power of the generator, becomes possible; (2) The dependability of electric-power generation is increased; (3) Servicing is simplified. D.B.

N63-12109 Western Radiation Lab., Los Angeles, Calif.
MICROMETER ACTUATOR, PHASE V: ELECTROSTRICTION PROTOTYPE, PZT-4 OSCILLATORS Technical Progress Report No. 5, 7 December 1961 thru 16 January 1962
Jan. 16, 1962 11 p
(Contract N123(60530)27426A)

The electrostrictive linear actuator has been tested and its performance exceeds that of any previously made. The amplitude of the clutch motion was measured microscopically at 0.0004 inch. Refinements are needed in the method for making fine adjustments. R.C.M.

N63-12200 Thompson Ramo Wooldridge, Inc. New Devices Labs., Cleveland, Ohio
SPACE RADIATOR STUDY Final Report—July 31, 1961
R. J. Denington, A. Koestal, A. V. Saule, G. T. Stevens, and R. B. Taylor [1962] 264 p refs
(Contract AF 33(616)-7368)
(ER-4544)

Design techniques are presented for condenser radiators for condensing mercury, sodium, potassium, and rubidium vapors for Rankine-cycle space-powerplants. Included in the design techniques are radiation heat transfer, fluid mechanics, meteoroid protection and materials considerations, with the fluid-mechanics stability aspects emphasized. Parametric data for large alkali metal condenser radiators relating geometry to weight and area are presented. Tests were conducted with water, sodium, potassium, and rubidium to investigate flow regime and stability in vertical up-flow condensing. A correlation is presented for predicting the transition from a stable annular film flow to a slugging regime. Techniques for estimating pressure drop and inventory are provided. Condensing heat transfer coefficients for potassium and rubidium are measured and found to vary from 200 to 4000 Btu/hr ft^2 ° F. This report summarizes the recommended design procedures, parametric data, and the experimental details. Author

N63-12295 National Aeronautics and Space Administration, Washington, D.C.
SPACE COMMUNICATIONS
Gerald M. Truszynski Washington, GPO, 1963 23 p Based on a talk at the annual meeting of the Air Traffic Control Assoc., Las Vegas, Nev.
GPO: $0.15

The traffic control problems handled by space communication systems are outlined; and the stations and networks which NASA uses for tracking and acquiring data from spacecraft are described. The Mariner and Gemini missions are described to illustrate the complexity of typical communications problems. The traffic control problem with spacecraft is compared to the aircraft problem. It is concluded that the communications capability for aircraft could be improved by the application of some of the techniques used for spacecraft. R.C.M.

N63-12311 Atomics International, Canoga Park, Calif.
APPLICATION OF SNAP 2 TO MANNED ORBITAL SPACE STATIONS
H. Estrada, V. Keshishian, J. Konklin, and H. N. Rosenberg, ed. Dec. 16, 1962 92 p 10 refs
(AI-7905)

The results of a study of the installation and operational characteristics of a SNAP reactor system integrated with a manned space station are presented. The system selected was an 11-kwe version of a SNAP 2 system employing multiple power-conversion units coupled to a single reactor source. The installation and shielding requirements of the 11-kwe system were considered for two types of space-station configurations; one was a 10 ft. diam. cylindrical station with a reactor separation distance of 50 ft. and the other a 150 ft. diam. torodial station with the reactor located in the hub. The weight of the power system installed in the cylindrical space station was about 9000 lb. of which 6000 lb. were required for shielding. The weight of the system for a torodial station was ~25,000 lb. of which 20,000 lb. was required for shielding. These weights are relatively insensitive to power level, and doubling or tripling the power output will only increase these weights by a small percentage. In addition, the designs developed for these two concepts permit the replacement of the reactor and power-conversion system, with the radiation shields becoming essentially a permanent part of the space station. Hence, the large weight penalty associated with the reactor shield only has to be incurred once during the life of the space station. Parametric curves of shielding weight are presented to enable the space vehicle designer to estimate nuclear power system weights for configurations other than those selected in this report. Author

07 CHEMISTRY

Includes: chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis.

For related information see: 18 Materials, Metallic; 19 Materials, Non-metallic; and 26 Propellants and Combustion.

N63-11962 Princeton U. Frick Chemical Lab., N.J.
THE ROLE OF HYDROGEN BONDS IN THE VISCOELASTIC PROPERTIES OF AMORPHOUS POLYMER NETWORKS. I. MODULUS-TEMPERATURE STUDIES. II. MODULUS-TIME STUDIES
M. C. Shen and A. V. Tobolsky Jan. 1963 41 refs
(Contract Nonr 1858(07))
(ONR-TR-RLT-55)

The influence of hydrogen bonds on the viscoelastic properties is studied by constructing the modulus-temperature curves of a series of homopolymers and copolymers of methacrylates. It is seen that only the inflection temperatures change as a function of the degree of hydrogen bonding. The glassy moduli, the rubbery moduli, and the slopes at the transition region remain essentially constant. Physical interpretations on the molecular scale are given to explain the experimental observations. Author

N63-11997 California U., Berkeley. Lawrence Radiation Lab.
THE CHEMISTRY OF HEXACHLORODIGERMANE
Richard Wilhelm Kopp (M. S. Thesis) Sept. 1962 59 p 53 refs
(Contract W-7405-eng-48)
(UCRL-10437) OTS: $1.50

Hexachlorodigermane was prepared by a microwave-discharge method, and its physical properties were determined. The reactions of this compound with $NaBH_4$, H_2O, NH_3 and HCl were investigated because hexachlorodigermane is one of the few inorganic compounds known which contain the Ge-Ge bond. A review of organic compounds containing this bond is presented, and a comparison is made with compounds containing the Si-Si and Sn-Sn bonds. M.P.G.

N63-12000 California U., Berkeley. Lawrence Radiation Lab.
THE EFFECTS OF ION HYDRATION IN SOLVENT EXTRACTION AND ION EXCHANGE
David C. Whitney (Ph. D. Thesis) Oct. 12, 1962 195 p 170 refs
(Contract W-7405-eng-48)
(UCRL-10505) OTS: $2.75

The extraction of $HClO_4$, $HReO_4$, HBr, HNO_3, $HAuCl_4$, and $HAuBr_4$ into dilute solutions of tributyl phosphate (TBP) in inert diluents has been studied, and the extracting species and extraction mechanism have been determined. It has been found for all the acids except HNO_3 that so long as the TBP concentration is $\leq$ 0.1 M and the stoichiometric ratio TBP/H^+ is $\geq$ 3 the only extracting species are the molecular adduct $TBP{\cdot}H_2O$ and the solvated hydronium ion $3TBP2H_3O^+{\cdot}mH_2O...X^-$, an ion pair, where $O \leq m \leq 1$. For $1 < TBP/H^+ < 3$ there are several possible species, whereas at $TBP/H^+ = 1$ the only species present in the organic phase is the salt $TBPH^+...X^-$. HNO_3 is found to extract as an anhydrous molecular adduct at all TBP and HNO_3 concentrations such that TBP/HNO_3 is > 1; the HNO_3 that extracts in excess of 1:1 with TBP is partially hydrated. These results are interpreted in terms of a proposed general model for such strong-acid-basic-solvent extraction systems. Also, anion-exchange studies on the salts of the fattyacids have been carried out by using a quarternary ammonium (strong-base) resin. The elution of tracer alkali metal and trivalent cations from cation-exchange resin columns by several uni-univalent salts and acids has been investigated.
Author

N63-12007 Hanford Atomic Products Operation, Richland, Wash.
PuO_2—UO_2 EURATOM TEST ELEMENTS
J. B. Burnham, Jr. Sept. 29, 1961 35 p

Twenty-one Zircaloy tubes were loaded with UO_2—1.5 PuO_2 sintered pellets. Analysis showed the average pellet density to be greater than 93% TD. The oxygen-to-uranium ratio was 2.018; the average plutonium content was 1.47 w/o. Author

N63-12022 Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.
PROCESS DEVELOPMENT. QUARTERLY PROGRESS REPORT JULY – SEPTEMBER 1962
J. H. Yeager et al Nov. 1, 1962 37 p 21 refs
(Contract W-14-108-eng-8)
(MCW-1479)

Results concerning process development of uranium and uranium compounds are as follows: (1) Maximum anode current densities have been measured for uranium electrolytic cells as a function of the uranium tetrafluoride concentration in the electrolyte. The effects of dissolved uranium dioxide on the maximum current densities have also been observed; (2) A stopper-rod and wire system, and a vacuum withdrawal system for tapping molten uranium from an electrolytic cell have been developed; (3) A sample of uranium tetrafluoride can be solubilized in 30 minutes by heating, in a quartz flask, in a mixture of ammonium sulfate, concentrated sulfuric acid, and boric acid until solidification occurs, and then dissolving the cooled solids in water; (4) Instrumentation for emission microspectroscopy features the use of the spark plasma envelope as the effective entrance slit of the spectrograph; (5) Methods for determining hydrogen in uranium which are based on complete separation of the gas by vacuum or inert gas extraction are the most satisfactory. I.v.L.

N63-12052 Midwest Research Inst., Kansas City, Mo.
SYNTHESIS OF ELASTOMERS CONTAINING Si-N BONDS IN THE MAIN CHAIN Quarterly Progress Report No. 5, 1 October-31 December 1962
L. W. Breed and R. L. Elliott Jan. 10, 1963 17 p
(Contract DA-23-072-ORD-1687)

Polymers containing silicon and nitrogen in the main chain with intrinsic viscosities (in toluene) up to 1.6 have been prepared by the condensation of hexamethylcyclotrisilazane with bisphenol "A". When 4,4'-dihydroxyphenyl is used as the diol, polymers with improved thermal stability are obtained. The screening of various other monomer compositions is described. The great stability of small ring silicon-nitrogen compounds under the influence of acidic and basic catalysts is demonstrated in a variety of experiments; however, some conversion of octamethylcyclotetrasilazane to hexamethylcyclotrisilazane was observed at 175° C in the presence of aluminum or ferric chloride. Author

N63-12055 Hanford Atomic Products Operation, Richland, Wash.
ALUM PRODUCTION STUDIES
G. Jansen, Jr. July 19, 1962 32 p 3 refs
(Contract AT(45-1)-1350)
(HW-73747 Rev.) OTS: $0.75

Analysis of crude bauxite feedstock by dissolution in 60 wt % H_2SO_4 indicated that 55.3 wt % is available Al_2O_3 and 15.8 wt % is insoluble material, largely hydrated aluminum silicates. In well-stirred vessels, conversions of available Al_2O_3 to alum as high as 92 percent were obtained with 5 to 8 pounds of bauxite per gallon of 93 wt % acid, 1 gallon water per gallon acid, apparent (no allowance for foaming) liquid holdup times of three minutes and operating temperatures of 130° to 135° C. Operation with poorer agitation under these conditions gave only 60 to 90 percent conversion, reaction temperatures as high as 160° C, and greater accumulation of unreacted solids in the bauxite reactor. The two most favorable candidates for long-life vessels and agitators are glass-lined steel and chlorinated polyether coated materials. Fluorocarbon polymers may also be used if adequate coating techniques are found. Author

N63-12102 Princeton U. Plasma Physics Lab., N.J.
DETERMINATION OF DIFFUSIVITY AND SOLUBILITY IN TWO PHASE SYSTEMS
Frederick W. Camp and Ernest F. Johnson Washington, AEC Div. of Tech. Information, Sept. 1962 37 p 4 refs Presented at Symposium on Experimental Techniques in Kinetics Studies, Amer. Inst. of Chem. Engineers Annual Meeting, Dec. 1962, Chicago Previously issued as MATT-115 For abstract of unabridged version see N62-12074 06-21
(Contract AT(30-1)-1238)
(MATT-148; MATT-115) OTS: $0.75

Determination of diffusivity and solubility in two-phase systems was investigated. The method involved following the concentration of the diffusing component in response to a step change in that concentration in a system where total volume and temperature are constant. The method described has the following advantages: (1) applicability to several types of experimental systems; (2) simultaneous measurement of the two parameters' diffusivity and solubility; (3) simplicity of construction and execution; and (4) rapid determinations. Determinations using this method are of an accuracy better than that which is required for many engineering design calculations. I.v.L.

N63-12140 Argonne National Lab., Ill.
THE NITRIDATION RATES OF URANIUM-FISSIUM ALLOYS
J. P. La Plante and R. K. Steunenberg Nov. 1962 30 p 78 refs
(Contract W-31-109-eng-38)
(ANL-6642)

The nitridation rates of uranium-five percent fissium alloys were investigated at temperatures from about 200° to 650° C and at nitrogen concentrations in argon from about 0.5 percent up to 100 percent. The effects of sodium coatings and irradiation of the alloy were examined. The nitridation rates of the alloys followed a parabolic law, with activation energies between 14 and 16 kcal/mole. The ignition behavior of irradiated alloy in nitrogen-argon mixtures was investigated briefly. Author

N63-12143 Reaction Motors Div., Thiokol Chemical Corp., Denville, N.J.
INORGANIC CHEMISTRY OF THE OXYGEN SUBFLUORIDES Second Quarterly Progress Report, 15 July-15 October 1962
T. Hirata, S. Morrow, and A. Young Oct. 15, 1962 15 p 8 refs
(Contract Nonr-3824(00); ARPA Order 314-62)
(RMD-5009-Q2)

A new hypothesis concerning the structure of the purple reaction products of O_2F_2 is discussed. It is proposed that the structure of O_2F_2 involves an unsaturated oxygen to oxygen bond to which chlorine and most compounds of monovalent chlorine may add. No colored addition products were observed with N_2O_4, octafluoro-1,4-dithiane, C_4Cl_4, and NOCl. However, the result obtained with NOCl may have been due to poor mixing of the reagents, and this reaction will be studied further. A white solid product which slowly evolves oxygen at room temperature was obtained by the reaction of O_2F_2 with antimony pentafluoride. It is possible that this compound is a new O_2^+ derivative (O_2SbF_6). Author

N63-12216 Purdue Research Foundation, Lafayette, Ind.
PREPARATION OF PHOSPHONITRILE MONOMERS Final Report, January 16, 1956 to November 30, 1962
E. T. Mc Bee [1962] 51 p 33 refs
(Contracts DA-33-008-ORD-1156 and DA-33-008-ORD-2131)
(AROD-1395-10)

The treatment of $(PNCl_2)_3$ with n-butyl amine and allyl amine gave monohydrochlorides of the following structures: $P_3N_3(NHR)_4HCl$. The infrared spectra of these amides were compared to the infrared spectrum of $(PNCl_2)_3$ $\cdot HClO_4$. The position of the proton in the hydrochlorides is discussed. An oct-indoyl amide of tetramer was prepared by treating $(PNCl_2)_4$ with potassium indole in benzene. A similar reaction with $(PNCl_2)_3$ led to a variety of products. Potassium carbazole gave a tetra substituted product. Pentaphenoxychlorocyclotriphosphazene (m.p. 69° - 71° C) or an isomeric mixture of tetraphenoxydichlorocyclotriphosphazene was obtained by the treatment of $(PNCl_2)_3$ with sodium phenoxide in an appropriate mole ratio. From the former an isomer (m. p. 75° to 77° C) was isolated, which on ammonolysis gave an isomer (m.p. 118° to 120° C) of tetraphenoxydiaminocyclotriphosphazene. Ammonolysis of the isomeric mixture gave the same amide and a second isomer (m.p. 110° to 111.5° C). The third isomer (m.p. 104° to 106° C) was obtained by the reaction of tetrachlordiaminocyclotriphosphazene and sodium phenoxide. Three isomers (m.p. 210° to 212° C, 135.5° to 137° C and 188° to 199° C) of triphenoxy-triaminocyclotriphosphosphazene were also obtained. Author

N63-12217 Duke U., Durham, N.C.
CERTAIN REACTIONS OF ORGANOMETALLIC COMPOUNDS AND SOME CYCLIZATIONS Final Report, September 1, 1955-December 31, 1962
Charles R. Hauser [1962] 14 p
(Contract DA-36-034-ORD-2040)
(AROD-1443-55)

Results of studies on certain reactions of organometallic compounds and some cyclizations during the period 1 September 1955 to 31 December 1962, are summarized. Author

N63-12218 Oak Ridge National Lab., Tenn.
TRANSURANIUM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING AUGUST 31, 1962
D. E. Ferguson, comp. Feb. 1, 1963 59 p 6 refs
(Contract W-7405-eng-26)
(ORNL-3375) OTS: $1.50

Development of separation processes for the transuranium elements, process-equipment development, high-flux isotope-reactor target fabrication, design of the transuranium processing facility, design of development facilities, corrosion studies, analytical research and development, and the preparation of uranium-232 samples for research are described. Author

N63-12230 Joint Publications Research Service, Washington, D.C.
DEVELOPMENTS IN INORGANIC CHEMISTRY—USSR
Jan. 29, 1963 24 p 22 refs Transl. of 2 articles from Zhur. Neorg. Khim (Moscow), v. 7, nos. 5 and 9, May and Sept. 1962 p 975-979 and 2200-2205
(JPRS-17345) OTS: $0.75

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N63-12231 Joint Publications Research Service, Washington, D.C.
THE PRODUCTION AND SOME PHYSICAL AND CHEMICAL PROPERTIES OF YTTRIUM CARBIDES
G. V. Samsonov, T. Ya. Kosolapova, and G. N. Makarenko In its Developments in Inorganic Chemistry—USSR Jan. 29, 1963 p 1-10 8 refs (See N63-12230 05-07) OTS: $0.75

The physical and chemical properties of the yttrium carbides, YC, Y_2C_3, and YC_2 were investigated. These carbides were produced by reduction of yttrium oxide in vacuo at high temperatures: YC was formed at 1800° to 1900° C; Y_2C_3 at 1700° to 1800° C; and YC_2 at 1900° C. Compacted samples of the yttrium carbides were formed

by high-temperature pressing; sintering of the carbides produced homogeneous structures with distinct twinning. The microhardness, electrical resistivity, melting points, and solubility in water, acids, and bases are presented for all three carbides. These carbides are all unstable in air at room temperature: YC and Y_2C_3 oxidize to form oxycarbides; YC_2 oxidation is a slower process and does not involve oxycarbide intermediates. M.P.G.

N63-12232 Joint Publications Research Service, Washington, D.C.
ATOMIC STRUCTURE AND MECHANISM OF PLASTIC DEFORMATION OF SOLID SOLUTIONS
L. N. Guseva and A. A. Babareko *In its* Developments in Inorganic Chemistry—USSR Jan. 29, 1963 p 11-21 14 refs (See N63-12230 05-07) OTS: $0.75

The mechanism of plastic deformation of solid solutions was studied and related to atomic structure. These studies showed that the nature of the coefficient of relaxation T for solid solutions depends basically on the factors affecting the hardness of the alloys, and only slightly on changes in the strength of the interatomic bonds. There is a reverse proportionality between the hardness and the bonding strength characteristic. A comparison of the hardness with the modulus of elasticity E of copper solid solutions confirmed that the time required for relaxation of the deformation was so great that it almost cancelled the effect of E on resistance to plastic flow. M.P.G.

N63-12260 Directorate of Materials and Processes, Aeronautical Systems Div., Wright-Patterson AFB, Ohio
LITERATURE SURVEY ON SYNTHESIS, PROPERTIES, AND APPLICATIONS OF SELECTED BORIDE COMPOUNDS [Final Report, 1 Feb.-1 Aug. 1962]
Barry R. Emrich Dec. 1962 124 p 107 refs
(ASD-TDR-62-873)

A comprehensive review of the literature was made to assist in providing background information needed for future work concerning boride materials. The materials reviewed included solid bodies of TiB_2, ZrB_2, HfB_2, VB_2, NbB_2, TaB_2, CrB_2, and ThB_4. This compilation presents information on synthesis, properties, and applications of the selected boride compounds, including selected abstracts and articles. Author

N63-12305 Stanford Research Inst., Menlo Park, Calif.
ENERGY ACCOMMODATION IN EXOTHERMIC HETEROCATALYTIC REACTIONS
Bernard J. Wood, James S. Mills, and Henry Wise Charlottesville, Virginia U. School of Eng. and Applied Sci., Jan. 1963 21 p 19 refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(SRI-14-P)

The steady-state flux of mass and of energy at a solid catalytic surface due to heterogeneous recombination of hydrogen atoms was evaluated by a combination of EPR and calorimetric techniques. The catalytic surfaces employed were filaments of nickel, platinum, and tungsten. In general, only a fraction of the energy of atom recombination was found to be accommodated by the catalyst. The results suggest an upper limit to the energy flux which a solid can accept. This is interpreted to be governed by the lattice force constant of the catalyst which may be the rate-limiting factor in certain exothermic catalytic processes. Author

N63-12333 Brookhaven National Lab., Upton, N.Y.
DISTRIBUTION OF URANIUM AND CERIUM BETWEEN LIQUID BISMUTH-MAGNESIUM ALLOY AND LIQUID NaCl-KCl-$MgCl_2$ EUTECTIC
F. J. Salzano and F. B. Hill June 1962 21 p 13 refs
(Sponsored by AEC)
(BNL-639(T-210)) OTS: $0.50

The distributions of U and Ce between dilute solutions of Mg in Bi and the eutectic mixture of NaCl, KCl, and $MgCl_2$ have been measured at 500° C on a kilogram scale in metallic containers. The dependence of the distribution coefficients for Ce on the concentration of Mg in Bi was found to be reproducible and consistent with the stoichiometry of a reversible exchange reaction between the distributing solute and Mg. The coefficients for U behaved similarly but were not as reproducible. The observed average separation factor between Ce and U was 420. A conservative value is 100. No effects of using two methods of salt preparation, two container materials, and two salt/Bi volume ratios were clearly discernible. A partially reversible loss of U was observed which was attributed to the presence of impurities in the salt. Author

N63-12335 Brookhaven National Lab., Upton, N.Y.
RADIATION PROCESSING. REPORT NO. 5: COBALT-60 GAMMA IRRADIATION OF URANIUM AND HYDROCARBONS
Peter Colombo and Meyer Steinberg Aug. 1962 19 p 8 refs
(Sponsored by AEC)
(BNL-753(T-278)) OTS: $0.50

Gamma radiation from a cobalt-60 source was used to react uranium, uranium hydride, and uranium oxide with propane and other hydrocarbons in an attempt to form uranium monocarbide. A series of survey experiments were undertaken to determine the effect of temperature, concentration, and total dose. The carbide concentration was determined by chemical and X-ray analysis. With propane gas in excess of stoichiometric quantity, and at pressures up to 7 atm and room temperature, the conversion to carbide varied between 0.6% and a maximum of 5.0%. Increasing the hydrocarbon concentration to five times the stoichiometric amount had no effect on the yield through a range of radiation doses up to 80 million rads. At 350° C, in the absence of radiation, a conversion in the order of 5% was observed; the addition of the gamma radiation at 350° C gave no apparent increase in conversion. Cobalt-60 gamma radiation has a negligible effect in promoting the formation of uranium carbide from uranium and hydrocarbons. The low G-values indicate a non-chain type reaction mechanism. Author

N63-12350 Rice U., Houston, Tex.
THE CRYSTAL STRUCTURE OF VALERIC ACID
Ronald F. Scheuerman and Ronald L. Sass Repr. from Acta Cryst. (Copenhagen), v. 15, pt. 12, Dec. 1962 p 1244-1247 7 refs
(NASA Grant NsG-6-59)

A three dimensional X-ray study of crystalline valeric acid has shown it to be monoclinic with

$$a = 5.55,\ b = 9.664,\ c = 11.341\ \text{Å};\ \beta = 101° 49';\ Z = 4,$$

and space group C_3^{2h}–$P2_1/c$. The trial structure was obtained from a Patterson function of the a axis projection. The structure was refined by least-squares methods. The final structure consists of dimers located about a center of symmetry with a hydrogen bond distance of 2.63 Å. The observed interatomic distances are C–O = 1.35, 1.26 Å; C–C = 1.53, 1.53, 1.57, 1.57 Å. All intermolecular contact distances are normal. Author

08 COMMUNICATIONS

Includes: communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation.

For tracking stations see: 10 Facilities.

For related information see: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation; and 22 Navigation and Guidance.

N63-12048 Naval Medical Research Inst., Bethesda, Md.
INTERFERENCE AND ITS ELIMINATION Research Report No. 2
Myron L. Wolbarsht June 15, 1962 16 p 12 refs
(MR-005.09-1401.04)

Interference is the outside noise or undesirable signal in the output of the sensing and recording equipment used in biological research. An analysis of the causes of the electrical and mechanical interference is presented, together with some discussion of the ways of removing or minimizing the interference. Some of the common sources of interference are listed. A detailed scheme is presented for the detection and elimination of interference with reference to the high gain, high input impedance amplifier which is so generally used in biological research. Author

N63-12080 Pennsylvania State U. Ionosphere Research Lab., University Park
AUTOMATIC TUNING SYSTEMS FOR ANTENNAS WITH VARYING IMPEDANCE Scientific Report No. 173
J. F. Shoup Nov. 15, 1962 64 p 34 refs
(NASA Grant NsG-134-61)
OTS: $6.60 ph, $2.12 mf

Antennas used in rockets and satellites for propagation experiments are detuned by the ionosphere. Various methods are investigated for maintaining this tuning in order to increase the efficiency and reduce phase shifts in the system. Particular attention has been paid to those systems in which it is possible to make continuous measurements of the antenna impedance. A method is described for maintaining tuning of an antenna over a reactance range of 5:1. The system contains no moving parts, has a time constant of the order of 175 m.s., and is suitable for miniaturization. An output is available proportional to the antenna capacitance suitable for driving a telemetry subcarrier oscillator. Tests results for an experimental system are given. Author

N63-12083 Naval Radiological Defense Lab., San Francisco
A QUALITATIVE STUDY OF RADIO-FREQUENCY INTERFERENCE IN RADIAC-TELEMETRY SYSTEMS
H. A. Zagorites and D. Y. Lee Feb. 8, 1962 16 p 7 refs
(USNRDL-TR-544)

In an effort to better understand the effects of radio-frequency interference (RFI) and bandwidth limitation on data accuracy and reliability, a number of qualitative tests were made with an existing recycling electrometer type of radiation recorder coupled to a standard telemetry system. These tests, which showed that significant errors can result from RFI, demonstrated the need for system designs which minimize radio-frequency (r.f.) coupling to the high impedance elements of the radiation detector and circuitry. The RFI in the radiation recorder tested caused an increase in the recycling period of 20 percent or more under some conditions. This increase was attributed to the recharging of the radiation detector by the r.f. through the diode action of the electrometer tube. Also, it was found that the effect of bandwidth limitation on the transmitted pulse output of the recorder was small and that the system accuracy was not significantly lowered. However, system noise reduced reliability at very low pulse repetition rates. The test results showed that potential RFI problems exist in radiac-telemetry systems. Most of these problems can be met satisfactorily through the use of common r.f. elimination techniques. Author

N63-12131 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.
COHERENT DETECTION ON PULSED RADARS Research Report
Anthony Kerdock June 1962 40 p 4 refs
(Grant AF-AFOSR-62-295)
(PIBMRI-1103-62)

Coherent detection on a pulsed radar is discussed from a statistical decision theory viewpoint. The Neyman Pearson test is applied to two cases; first, where it is desired to detect targets moving with one particular radial velocity, and second, where it is desired to detect targets at all velocities equally well. In the first case it is shown that, in a sense, an ideal integrator is achieved; i.e., the results are exactly the same as if all the power reflected from the target were received in one pulse, rather than many. A mechanization for the second case is given. The statistics for a suboptimum integrator which approximates the Neyman Pearson test in a simpler form are derived. The performance of this integrator is compared with that for the ideal noncoherent integrator. Author

N63-12210 National Bureau of Standards. Central Radio Propagation Lab., Boulder, Colo.
METHODS FOR APPLYING NUMERICAL MAPS OF IONOSPHERIC CHARACTERISTICS
William B. Jones and Roger M. Gallet Repr. from J. Research Nat. Bur. Standards v. 66D, no. 6, Nov.-Dec. 1962 p 649-662
5 refs

A solution has recently been given [Jones and Gallet, 1962] to the problem of representing the complex variations of ionospheric characteristics on a worldwide scale, including their diurnal variation, by numerical analysis of ionospheric data as measured at the stations, without prior hand operations. Whereas the paper referred to above deals with "how to make numerical maps," the present paper is concerned with "how to use a numerical map" once it has been obtained. Included are (1) a precise definition of a numerical map, (2) efficient computing procedures for applying numerical maps, including a general method for computing worldwide (or polar) contour maps in either universal time or local mean time, and (3) a large selection of graphical illustrations computed automatically from a numerical map. Author

N63-12283 Army Map Service, Washington, D.C.
RANGE ERROR ANALYSIS
Alice G. Sturdivant Sept. 1962 90 p 2 refs
(Tech. Rept. 45)

The sample worldwide satellite tracking program carried out by the Army Map Service is described. By using satellites with known heights and inclinations and the coordinates of known points on geodetic datums, the coordinates of unknown points were related to these datums. The known and unknown points used in each segment of the program are presented, and the probable error in the correction to each unknown point is given. Author

N63-12297 Cutler-Hammer, Inc. Airborne Instruments Lab., Deer Park, N.Y.
STUDY AND DEVELOPMENT OF A SELECTIVE MONITORING SYSTEM Technical Documentary Report [June 1961-July 1962]
George W. Morton and Allen I. Ligorner Wright-Patterson AFB, Ohio, Biomedical Laboratory, Dec. 1962 31 p 2 refs
(Contract AF 33(616)-8370)
(AMRL-TDR-62-144) OTS: $1.00

To reduce the load on data transmitting and processing equipment, and thereby reduce the size and power requirements of such equipment in space vehicles, methods of selecting only the significant portions of data from transducers were investigated. A six-channel laboratory model of a selective monitoring system was built and tested. Two principles of data selection were studied; (1) selection based on departure of a process variable from the steady state, and (2) excursion of a process variable beyond predetermined limits. Selection data while in the analog state, as taken directly from the transducers, and selection data after conversion to digital code were studied. The laboratory model demonstrates selective monitoring of analog data after conversion to digital code, and uses as a selection criterion either departure from the steady state or excursion beyond limits. A program for applying the knowledge and the principles demonstrated to space-vehicle equipment is described. Author

09 ELECTRONICS

Includes: circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory.

For related information see: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N63-11952 Stanford Research Inst., Menlo Park, Calif.
INTEGRATION OF ENERGY STORAGE AND DISCHARGE MECHANISMS IN BULK SILICON AND GERMANIUM FOR APPLICATION TO NEURISTOR LINES **Interim Report 6**
D. R. Chambers Oct. 1962 28 p 5 refs
(Contracts Nonr-3212(00) and AF 33(657)-7801)

The feasibility of combining the energy storage and energy discharge mechanisms of a parallel thermistor-capacitor combination into a single structure is explored. The pertinent relations required to determine this feasibility are developed and applied to the materials silicon and germanium. It is found that the electric field strengths required to accomplish this integration of functions is critically high. Cooling the materials to below 10° K appears helpful, but the onset of impact ionization at these temperatures voids the gains made in the reduction of the required electric field strength. It is argued that thermistor materials such as silicon and germanium, that derive their negative temperature coefficient of resistivity from the thermal excitation of carriers into the conduction band, appear incapable of supporting the desired integration of device functions. This does not rule out, however, structures with added energy storage or structures relying on a different mechanism for the resistance change such as superconductivity. Author

N63-11953 Montana State Coll. Endowment and Research Foundation. Electronics Research Lab., Bozeman
ON CYCLING BEHAVIOR IN 1-DIMENSIONAL, BILATERAL ITERATIVE NETWORKS **Scientific Report No. 3**
W. L. Kilmer Aug. 1962 57 p 6 refs
(Contract AF 19(604)-6619)
(AFCRL-62-728)

This paper concerns the dynamic behavior of bilateral, combinational-cell iterative networks. All n cells in such networks are identical, and each cell is interconnected to both its right and left neighbor through unit-delay, discrete-variable, information lines. This allows synchronous operation. A network is said to "steady-state cycle" if its total input-variable and internal-variable signal configuration recurs periodically in time. Such cycling phenomena is studied by reinterpreting network cell structure in such a way as to exhibit the explicit "coupling" relation between signal sequences that occur at adjacent intercellular network sections. Arrays of regular expression formulae are used to denote these sequences for the case where effective coupling occurs in only one direction. In such cases, the array formulation is developed along existence lines to show that there are corresponding general types of steady-state cycling analysis problems that are logically unsolvable. Nevertheless, several interesting subclasses of such problems are easily solvable. The main purpose of the paper is to exhibit the essential character of steady-state cycling in large classes of repeated-structure logic networks. Author

N63-12012 Joint Publications Research Service, Washington, D.C.
FREQUENCY STEERING OF THE BEAM IN ANTENNA ARRAYS
B. A. Yegorychev Jan. 22, 1963 13 p Transl. from Tr. Mosk. Fiz.-Tekhn. Inst. (Moscow), no. 8, 1962 p 67-72
(JPRS-17225) OTS: $1.60

The frequency steering of the radiation pattern of an antenna array is examined, and a theory of frequency steering is derived. The formulas presented make it possible to determine design calculations of the parameters of linear and two-dimensional arrays for a given steering sector, as well as the number of lines, the width of the pattern, and the frequency deviation. D.B.

N63-12013 Joint Publications Research Service, Washington, D.C.
CYBERNETICS AND AUTOMATIC CONTROL
V. A. Trapeznikov Jan. 22, 1963 26 p Transl. from Vestnik Akad. Nauk SSSR (Moscow), v. 32, no. 5, May 1962 p 33-42 For abstract see N62-13104 09-19
(JPRS-17227) OTS: $2.60

The science of control is discussed, as it relates to both living organisms and automatic machines, to point out promising areas for further investigation. The possibility of teaching machines a recognition process opens unusual opportunities for automation. Advancements in this area should lead to machines which can control processes on both the visual and sonic parameters. A duplication of the adaptability of life forms is sought in machine processes through optimal selector mechanisms which provide flexible control plans. A breakthrough in this area is needed to achieve maximum level of effectiveness with automatic control. Another prerequisite for the further development of control systems is research on the relationship of the human operator to the system. The fulfillment of these needs will require the closest cooperation among mathematicians, physicists, chemists, physiologists, and psychologists. R.C.M.

N63-12044 Massachusetts Inst. of Tech. Electronic Systems Lab., Cambridge
A MECHANISM FOR 1/f NOISE OF THIN EVAPORATED METAL FILMS
Martin Seymour Osman (Ph.D. Thesis - Harvard U.) Sept. 1962 75 p 29 refs
(NASA Grant NsG-234-61; Contracts AF-33(657)-7644 and AF-33 (616)-7700)
(ESL-R-149) OTS: $7.60 ph; $2.45 mf

The present investigation begins with some observations of the salient characteristics of metal film noise, principally in gold films of less than 100 Å thickness. It is shown that the thin films which exhibit 1/f noise are of a discontinuous or agglomerated structure. The resistance characteristics of such films are primarily produced in the very small metallic volumes which form the contact regions or contact points between larger masses of the film material. The theoretical treatment idealizes the metal film as a matrix of such contacts. It is then shown how the electron population, and therefore the conductivity, associated with an individual contact may fluctuate with a "shot-noise" spectrum as a result of a "tunneling" barrier between the contact region and a trap formed by surface contaminants. The 1/f spectrum is generated by a distribution of trapping lifetimes for different traps. Of particular significance in this investigation has been the observation of a dependence of the mean square resistance fluctuation of both films and single contacts on the 5th power of resistance. A power dependence of this magnitude is shown by the theory to support the view that the 1/f noise arises from a carrier density fluctuation rather than a barrier modulation. Author

N63-12070 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.
ON THE DESIGN OF LINEAR PROCESS ADAPTIVE CONTROL SYSTEMS
Harry Nathan Yagoda Aug. 31, 1962 113 p 11 refs
(Contract AF 18(603)-105; Grant AF-AFOSR-62-280)
(PIBMRI-1075-62)

The problem of controlling a stable, slowly time varying, linear process is discussed. A solution is proposed that is simple, practical, and applicable to any finite order process. Use is made of a continuously adjusted tandem compensator; a comparison of the weighted histories of the input and output signals is used to control this

adjustment. System design is based upon the use of a variable transfer-function characterization for both the compensator and the process. In effect, a compensator is designed that attempts to cancel the variable poles of the process with variable zeros, the variable zeros of the process with variable poles, and the variable process gain with its reciprocal. Author

N63-12084 Purdue U. Automatic Control Center, Lafayette, Ind.
NONLINEAR THEORY AND APPLICATION
Rufus Oldenburger 11 p 7 refs Submitted for Publication
(NASA Grant NsG-28-59)
OTS: $1.60 ph, $0.80 mf

The rate of change of the controlling input to a physical system is generally bounded. For optimum response to step disturbances, the control of such a system is nonlinear. The mathematical problem of such control was solved by the author as far as appeared practical for engineering purposes. Major results of this theory and practical limitations are covered in this paper. Electric and hydraulic means for applying the theory in industry are presented. Author

N63-12086 Purdue U. Automatic Control Center, Lafayette, Ind.
OPTIMUM AUTOMATIC CONTROL
Rufus Oldenberger 17 p 5 refs Submitted for Publication
(NASA Grant NsG-28-59)
(OTS: $1.60 ph, $0.80 mf)

In the normal automatic control problem, the controlled variable is the output of the controlled system, whereas the controlling variable is the input. The rate of change of this input is usually bounded. A new approach for substantially improving control, that has proved very successful in the laboratory, is presented here. The value of this approach depends on distinguishing between controllable and uncontrollable disturbances. A properly designed controller must keep the controlled variable as near to its set value as possible, regardless of disturbances on the system. System disturbances may be approximated in practice by piecewise linear broken lines. Such approximations are accurate enough, and the controllable portions are usually of sufficient duration so that the controller chosen to be optimum for linear disturbances yields control that is substantially better for arbitrary disturbances than can be obtained by current known techniques. This new control approach involves simple control functions, and can be readily applied to industrial problems. Author

N63-12106 Stanford U. Solid-State Electronics Lab., Calif.
NONLINEAR DISTORTION IN FREQUENCY-DEPENDENT TWO-PORT SYSTEMS WITH APPLICATION TO COMMON-EMITTER TRANSISTOR AMPLIFIERS
Lit N. Ma Oct. 1962 73 p 7 refs
(Contracts Nonr-225(24); NR 373 360)
(Tech. Rept. 1611-1; SEL-62-093)

Nonlinear distortion is defined as departure from assumed linear behavior. For a class of frequency-dependent two-port systems, such departure can be obtained by representing the terminal current at each port by a Taylor series of four variables, viz, two terminal voltages and their first time derivatives. From this representation, a linear model for the solution of harmonic distortions in a two-port system can be constructed to consist of a set of harmonic current generators at each terminal in addition to the linear small-signal model. Such a model using harmonic current generators is valid for two-port systems which depart only slightly from linear behavior, and is suitable for use with general linear termination. Using this model, the solution for harmonic distortion is reduced to the solution of a sequence of linear equations. As an application of the analysis, the nonlinear distortion of alloy junction transistor amplifiers at low current levels is determined. The nonlinearities due to the "law of the junction" and the space-charge layer widening effect are considered. The frequency dependence of the terminal currents is attributed to the diffusion capacitance of the emitter junction and the transition capacitance of the collector junction. The nonlinearities of the low-frequency common-emitter short-circuit current gain β_o and the β cut-off frequency ω_β are also included. For second and third harmonic distortions, the harmonic current generators are obtained as functions of β_o, ω_β, built-in junction potential, collector capacitance C_c and collector resistance r_c at a given bias point, together with the bias condition and the fundamental frequency of the signal source. For a 2N192 audio transistor, the harmonic distortions at the operating condition having either the base-to-emitter port or the collector-to-emitter port short-circuited are calculated and measured. The results indicate that the model is valid over an extended range of frequencies and bias conditions. Author

N63-12185 Radio Corp. of America. RCA Labs., Princeton, N.J.
MAXIMIZING THE PERFORMANCE OF PHOTOCONDUCTORS Scientific Report No. 3, Covering the Period Mar. 13, 1962-Sept. 15, 1962
J. Dresner, ed., W. M. Anderson, R. H. Bube, A. B. Dreeben, E. L. Lind, and P. Mark David Sarnoff Research Center, Nov. 14, 1962 68 p 60 refs
(Contract AF 19(604)-8353)
(AFCRL-62-927)

A general discussion of the problems of charge transport and contacts to wideband gap materials is given, followed by a review of the applicable experimental techniques. The interpretation of Hall effect measurements in insulators and the related experimental problems are discussed. A time-of-flight method for studying carrier transport in insulators is reviewed. This consists of a measurement of the transit time of injected excess carriers flowing under space-charge limitation. A general analysis of unipolar steady-state space-charge limited currents in insulators with nonplanar electrode geometries is presented. The electrical properties of the arsonium salt of tetracyanoquinodimethane (TCNQ) are examined in a preliminary effort to determine the contact properties of this material. It is concluded that this material behaves as p-type semiconductor with promising application as an injecting contact to insulators. Author

N63-12319 Aerospace Information Div. Library of Congress, Washington, D.C.
MICROMINIATURE DEVICES FOR ELECTRONICS
Jan. 17, 1963 4 p Review of: R. S. Kil'metov, A. V. Kovalev, and Ye. B. Mekhantsev First scientific and technical conference of schools of higher education on the microminiaturization of radioelectronic devices; and Yu. P. Yermolayev Prospective and rational structures of printed resistors in microminiature equipment Izv. Vysshikh Uchebn. Zavedenii, Radiotekhn. (Kiev), v. 5, no. 4, 1962 p 538-539 and 469-475
(AID-S-63-13) OTS: $1.10 ph, $0.80 mf

Methods are offered for the elimination of the local overheating in microminiature printed resistors: (1) by making holes in the resistive film near the inner surface; (2) by placing low resistance sectors over the curved section of the resistor; (3) by using a conductive jumper instead of a curved resistor section; (4) by placing the curved section of the resistor over a conductive film; and (5) by increasing the width of the curved section. A.R.B.

N63-12322 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.
THE RESPONSE OF AN AUTOMATIC PHASE CONTROL SYSTEM TO FM SIGNALS AND NOISE
Donald L. Schilling (Ph. D. Thesis) June 1962 145 p 26 refs
(Contract AF118(600)-1505; Grant AFOSR-62-295)
(PIBMRI-1040-62)

An automatic phase control system is analyzed to determine its response to frequency-modulated signals and narrow-band Gaussian noise. Emphasis is placed on the system's response to frequency ramp modulated signals. The response of the system to a frequency ramp

modulated signal was obtained, the initial conditions required for the system to synchronize to a frequency ramp modulated signal determined, and the use of the system as an FM demodulated discussed in detail. It is shown that the system responds to noise as an open-loop system rather than as a closed-loop system. The phase jitter present in the output of the system is shown to represent a nonstationary Gaussian distribution. It is shown that a critically damped system can tolerate a lower S/N ratio than an underdamped or overdamped system. Author

N63-12323 Polytechnic Inst. of Brooklyn. Microwave Research Inst., N.Y.
ON THE MINIMAL SET OF COMPATIBLES FOR CLOSURE
William C. W. Mow Oct. 1962 41 p 2 refs
(Contract AF 18(600)-1505; Grant AFOSR-62-295)
(PIBMRI-1084-62)

Given an incompletely specified sequential switching function in the form of flow table, Paull and Unger had provided a systematic procedure for reducing the function into a set of maximum compatibles. A technique is presented for selecting a minimal closed set of compatibles without the process of enumeration. The rules have been applied to numerous examples, including those presented by Paull and Unger. Author

N63-12325 Joint Publications Research Service, Washington, D. C.
CORRELATION METHOD FOR RECOGNIZING PATTERNS
V. A. Kovalevskiy Jan. 31, 1963 15 p 6 refs Transl. from Zh. Vychislitel'noi Mat. i Matematicheskoi Fiz., (Moscow), v. 4, no. 4, 1962 p 684-694
(JPRS-17391) OTS: $0.50

The task of recognition consists of classing each pattern in one specific grade, also denominated image. The complicity of the task of recognition depends on the setup of the classes. A study is made of the classes, with each class being set up by means of a certain standard pattern in such a way that all patterns of a given class arise from the standard pattern, as an issue of distortions described through definite statistical regularities. These distortions might cover, for instance, investigations on darkening of the background, shift of the pattern, proportionate increase in the measures of the pattern, incidental darkening or lightening of certain points. Author

N63-12344 Argonne National Lab., Ill.
TUNNEL DIODE CIRCUIT ANALYSIS
Ronald G. Roddick Oct. 1962 51 p 12 refs
(Contract W-31-109-eng-38)
(ANL-6634)

Several graphical and graphico-analytical methods for solving nonlinear differential equations are analyzed and used in the solution of the most common configurations for tunnel diode circuits. The general procedure is to perform a first integration in the phase plane and then to obtain the time-dependent solutions by a second graphical integration. The operating modes and stability of tunnel diode circuits are analyzed, and a useful parameter diagram is presented. Examples are analyzed in connection with the different methods. Though tunnel diode circuits may be solved by means of an electronic computer, it is believed that these simple and easily applied methods give a valuable insight into the behavior of circuits under various operating conditions. Author

10 FACILITIES

Includes: airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations.

For related information see: 06 Auxiliary Systems.

N63-12101 Plasmadyne Corp., Santa Ana, Calif.
HYPERTHERMAL RESEARCH TUNNEL DEVELOPMENT AND TRANSPORT PROPERTY MEASUREMENTS Final Summary Report [June 1959-December 1960]
Daphne Christensen and Rolf D. Buhler Jan. 30, 1962 134 p 16 refs
(Contract DA-04-495-ORD-1313)
(FRO81-1313)

This summary of research and development activities include: (1) description of the steps leading to the completion of the Plasmadyne-NASA Hyperthermal tunnel; (2) arc-wind tunnel facility and flight simulation capability; (3) a brief review of arc-generator development technology; and (4) a summary of plasma diagnostic and calibration experiments carried out in the facility. I.v.L.

N63-12219 Oslo U. Inst. of Theoretical Astrophysics, Blindern (Norway)
CONSTRUCTION AND OPERATION OF OSLO SPACE TRACK STATION Supplement for the period July 15 to Oct. 1, 1962 to Final Report for the period Apr. 15, 1959 to July 14, 1962
Hallvard Rosseland Oct. 1962 10 p
(Contract AF 61(052)-240)
(ESD-TDR-62-336)

Satellite movements are observed with a Baker-Nunn tracking camera. Successful observations numbered 668. Failures, and factors causing failure, were tallied as follows: no satellite recorded on film - 331, cloud or fog interference - 88, observer's error - 13, technical or film trouble - 31, interference of moon - 7, suspected prediction errors - 7, inadequate elevation - 2, and phototrack too faint for measurement - 7. The problem of incurring a high percentage of cases where the tracked object fails to appear on the camera film is discussed in relation to possible causative agents. Lastly, the delaying factor of film processing is presented in connection with the possible application of recently developed high-speed instant films. A.R.B.

N63-12316 Oak Ridge National Lab., Tenn.
GAS-COOLED REACTOR PROGRAM. Semiannual Progress Report for Period ending September 30, 1962
W. D. Manly Feb. 1, 1963 471 p refs
(Contract W-7405-eng-26)
(ORNL-3372) OTS: $5.50

Progress in a gas-cooled reactor program is presented in the following areas: (1) investigations in support of the experimental gas-cooled reactor (performance analyses, structural investigations, component development and testing, materials development, irradiation testing of components and materials, experimental facilities); (2) pebble-bed reactor experiment (design and development studies, system analyses, and heat transfer and fluid flow in packed sphere beds); (3) advanced reactor design and development (investigations of fueled graphite and moderator materials, clad fuel development, design studies of advanced systems, experimental investigation of heat transfer and fluid flow, and facilities and equipment). D.B.

N63-12317 Argonne National Lab., Ill.
DESIGN SUMMARY REPORT ON THE JUGGERNAUT REACTOR
J. R. Folkrod, G. Ember, W. Kolb, J. Saluja, and D. P. Moon Sept. 1962 129 p 2 refs
(Contract W-31-109-eng-38)
(ANL-6616)

The design and operating characteristics of the Juggernaut reactor are summarized. This reactor is a light-water-cooled-and-moderated, graphite-reflected, heterogeneous, thermal reactor designed to provide experimental facilities for basic research in the range of neutron flux up to 4.0×10^{13} n/(cm^2)(sec) at an operating power level of 250 kw. A component description and cost analysis of the facility are included. R.C.M.

N63-12318 Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, DECEMBER 1962
Albert V. Crewe Jan. 15, 1963 53 p 5 refs
(Contract W-31-109-eng-38)
(ANL-6672)

Technical progress in specific reactor development projects and the related general engineering research and development programs are reported. Discussions are presented of the following: water-cooled reactors, liquid-metal-cooled reactors, general reactor technology, plutonium recycle reactor program, advanced systems research and development, and nuclear safety. D.B.

11 FLUID MECHANICS

Includes: boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow, 03 Aerodynamics of Wings and Control Surfaces; 13 Heat Transfer; and 24 Physics, Plasma.

N63-11956 Space Technology Labs., Inc., Redondo Beach, Calif.
ERROR ANALYSIS OF THE LINEARIZED METHOD OF CHARACTERISTICS FOR NONEQUILIBRIUM FLOW
J. T. Lee, Jr., and A. G. Hammitt May 18, 1962 29 p 3 refs
(Contract AF 04(694)-1)
(Rept. 6130-6184-KU000; BSD-TDR-62-118)

The pressure on an infinite sinusoidal wall in steady two-dimensional supersonic flow of an inviscid gas in vibrational or chemical nonequilibrium is obtained by the linearized method of characteristics and compared to the analytical solution of the linearized equations previously obtained by Vincenti. The system of "frozen" characteristics is used. At near-equilibrium conditions the error in the method of characteristics is due entirely to the error in integrating rate equation along the streamlines and can be made arbitrarily small by decreasing the size of the characteristic net. There appears to be no approximate criteria for reducing the error at near-equilibrium conditions by switching over to the system of equilibrium characteristics which are applicable to the entire flow field. Author

N63-11957 James Forrestal Research Center, Princeton U., N.J.
BOUNDARY LAYER FLOW WITH SUSPENDED PARTICLES
H. H. Chiu Aug. 1962 36 p 2 refs
(Contract AF 49(638)-465)
(Aeronautical Eng. Rept. 620)

The laminar boundary-layer flow with particles injected upstream of the leading edge of a plate is investigated. The boundary-layer equations for the gas, and the equations governing the rate of momentum and heat transfer between the gas and the particles have been solved simultaneously. A series solution is constructed (in terms of a system of universal functions) from which the solution for the arbitrary velocity and temperature ratio of the gas and the particles at the leading edge may be calculated. A closed-form solution is obtained for the particle motion. It is found, within the validity of the approximation, that the wall shear force may be larger or smaller than that of the flow of clean gas, depending on the relative magnitude of the velocity of the particles and the gas at the leading edge; and that the wall heat transfer depends primarily on the relative magnitude of the temperature of the particles and the gas at the leading edge, and upon the wall temperature. Author

N63-11958 James Forrestal Research Center, Princeton U., N.J.
EXPERIMENTAL INVESTIGATION OF BOUNDARY LAYER TRANSITION ON A FLAT PLATE WITH A POINT HEAT SOURCE AT THE LEADING EDGE
W. J. Mc Croskey Aug. 1962 32 p 27 refs
(Contract AF 49(638)-465)
(Aeronautical Eng. Rept. 623)

An experimental investigation of the variation of transition Reynolds number on a roughened flat-plate model with a heat source of strength, Q, spanning the leading edge is described. The present problem is compared with the problem of an aerodynamically heated boundary layer on an insulated flat plate. Transition Reynolds number was found to increase with increasing S over a range equivalent to a Mach number variation of $0 < M_\infty < 0.6$. Author

N63-11959 Aerojet-General Corp., Sacramento, Calif.
ANALYSIS OF THE FLOW OF GAS-PARTICLE MIXTURES IN TWO-DIMENSIONAL AND AXISYMMETRIC NOZZLES
J. D. Hoffman Dec. 1, 1962 132 p refs
(Contract AF 33(600)-36610)
(Rept. 0162-01TN-16; AFBSD-TDR-62-144)

From theoretical studies of two-phase flow of gas-particle mixtures in rocket nozzles, the governing equations for two-dimensional and axisymmetrical flows have been derived. A mathematical model has been developed for a general interior point in the supersonic field. The subsonic and transonic fields have been investigated. To integrate the subsonic, transonic, and supersonic solutions, a mathematical model will be programed for the IBM 7090 computer that will determine nozzle performance for given nozzle contour and motor contour and motor conditions. Author

N63-11966 Southwest Research Inst., San Antonio, Tex.
EXPERIMENTAL DETERMINATION OF OSCILLATORY LIFT AND MOMENT DISTRIBUTIONS ON FULLY SUBMERGED FLEXIBLE HYDROFOILS Technical Report No. 2
Guido E. Ransleben, Jr., and H. Norman Abramson Nov. 1, 1962 94 p 9 refs
(Contract Nonr-3335(00))

Measured spanwise distributions of steady-state and oscillatory lift and moment on fully submerged cantilever hydrofoils are presented. The hydrofoils were of aspect ratio 5 rectangular planform, and were towed at speeds sufficiently low to avoid cavitation. The data are compared with theoretical predictions and wind-tunnel data previously obtained at higher values of reduced velocity. Author

N63-11981 General Electric Co. Space Sciences Lab., Philadelphia, Pa.
THE APPROXIMATE FLOW CHARACTERISTICS IN THE BASE REGION OF A HYPERSONIC AXI-SYMMETRIC BODY
K. S. Wan Sept. 1962 36 p 1 ref
(Contract AF 04(647)-269)
(R62SD16-Class 1)

An approximate method of solution is given to determine the location of the rear stagnation point in the viscous base-flow region together with the size of the viscous wake and the flow-characteristics there. It is useful as a means of obtaining the initial conditions for the near-wake calculations. The results obtained show that one must consider the finite boundary layer at the base in determining the location of the rear stagnation point and the viscous-wake width there. In general, the viscous wake at the rear stagnation point consists of a shell of hot gas surrounding a cool core. Author

N63-12025 Aeronautical Research Labs., Wright-Patterson AFB, Ohio
ON SURFACE MASS TRANSFER EFFECTS IN A BINARY FLUID
Arthur N. Tifford Aug. 1962 41 p 19 refs
(ARL-62-396)

A relatively basic study of surface mass transfer effects in a nonreacting binary fluid has been conducted. The more significant findings are: (a) At least one of the surface boundary conditions employed in the extensive analytic boundary layer literature on the subject is generally an incorrect representation of the physical conditions actually existing at the surface. A reformulation rectifying this deficiency is recommended. (b) The concept of a columetric displacement mechanism of effectiveness of injected low molecular weight gases, previously found by the author to be appropriate for zero pressure gradient boundary layers in a steady flow field, is applicable no matter whether the flow fields be steady or unsteady, potential or viscous, creeping or boundary layer, etc. Author

N63-12026 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
HYPERSONIC SHOCK LAYER AT LOW REYNOLDS NUMBER—THE YAWED CYLINDER
H. K. Cheng and A. L. Chang Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Oct. 1962 72 p 47 refs
(Contract AF 33(616)-7812)
(ARL-62-453)

Low-density hypersonic flows are studied theoretically using the concept of a thin shock layer. The approach is applied to the problem of a cylinder at yaw, and to the analyses of vorticity interaction in the stagnation region for both axisymmetric and plane flows. A detailed discussion of the basic flow model is also made. Author

N63-12098 James Forrestal Research Center, Princeton U., N.J.
SOME RESULTS FOR PLANE POISEUILLE FLOW OF RAREFIED GASES
Y. P. Pao Aug. 1962 18 p 4 refs
(Contract AF 49(638)-465)
(Aeronautical Eng. Rept. 619)

Reasonably close upper and lower bounds are obtained for the number flux on the walls of a long two-dimensional channel under free molecular conditions. These results are used to infer the existence of the minimum in the flow rate. Author

N63-12103 Union Carbide Nuclear Co. Flow Research Lab., Oak Ridge, Tenn.
A SIMPLIFIED MODEL FOR THE AXIAL FLOW IN A LONG COUNTERCURRENT GAS CENTRIFUGE
A. S. Berman Jan. 25, 1963 25 p 8 refs
(Contract W-7405-eng-26)
(K-1535) OTS: $0.50

A model is proposed to describe the flow in a long countercurrent gas centrifuge. The model provides for a central feed tube and a radial temperature gradient. Since the ends of the centrifuge and, hence, the actual driving forces for the internal flow are ignored, a term is included in the equations of motion to provide a driving force whenever a thermal gradient is present. The solutions to the simplified equations of motion and energy with the appropriate boundary conditions lead to a description of the radial variation of density, temperature, and axial velocity. Author

N63-12132 Polytechnic Inst. of Brooklyn, N. Y.
AN INVESTIGATION OF A THREE-DIMENSIONAL TURBULENT BOUNDARY LAYER IN HYPERSONIC FLOW Interim Report
Gennaro F. Aiello Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Dec. 1962 50 p 24 refs
(Contract AF 33(616)-7661)
(PIBAL-773)

Turbulent heating rates have been measured by means of the shrouded model technique on a blunted cone at angle of attack. The Reynolds number, based on conditions at the stagnation point, was varied from 1.7 10^6 to approximately 3.7 10^6. The enthalpy ratio (stagnation to wall) varied from 2.1 to approximately 1.5. The experimental data are compared to the flat-plate reference-enthalpy theory applied along the inviscid streamlines. It is shown that this relatively simple method is in reasonable agreement with the data. Author

N63-12153 Purdue U. School of Mechanical Engineering, Lafayette, Ind.
DYNAMIC RESPONSE OF FLUID LINES
A. F. D'Souza and R. Oldenburger [1962] 40 p 15 refs
(NASA Grant NsG-28-59)
OTS: $3.60 ph, $1.40 mf

The use of hydraulic transmission lines in automatic control, liquid propellant rocket, and other systems requires a working understanding of their dynamic behavior. In this paper, the effects of fluid viscosity and compressibility are included to derive transfer functions relating the pressure and velocity variables at the two cross sections of a line. The results of theoretical analysis are compared with experimental data obtained from frequency response tests. The analysis includes the significant effect on the dynamic response caused by the natural frequency of vibration of the line in the longitudinal direction. It is shown that in small diameter lines the viscous effects cannot be neglected. The theoretical analysis may be used to improve the performance of systems incorporating hydraulic networks. Author

N63-12180 Guggenheim Aeronautical Lab., Calif. Inst. of Tech., Pasadena
STABILITY OF THE COMPRESSIBLE LAMINAR BOUNDARY LAYER
Lester Lees and Eli Reshotko Repr. from J. Fluid Mech., v. 12, pt. 4, 1962 p 555-590 27 refs
(Partially supported by NASA; Contract DA-04-495-ORD-19)

A study is made of the stability of the compressible laminar boundary layer and includes the effect of temperature fluctuations on the viscosity and thermal conductivity boundary layer. It is shown that the rate of conversion of energy from the mean flow to the disturbance flow through the action of viscosity in the vicinity of the wall increases with Mach number. Instead of being nearly constant across the boundary layer, the amplitude of inviscid pressure fluctuations, for Mach numbers greater than 3, decreases markedly with distance outward from the plate surface. This behavior means that the jump in magnitude of the Reynolds stress in the neighborhood of the critical layer is greatly reduced. At Mach numbers less than 2, dissipation effects are minor, but they become extremely important at higher Mach numbers, since for neutral disturbances they must compensate for the generally destabilizing effects of items. Since the wave number varies like $1/M_e^2$ when $M_e > 1$, the minimum critical Reynolds number is likely to increase sharply at hypersonic speeds. J.R.C.

N63-12183 Technical Research Group, Syosset, N. Y.
REPORT ON A SEMINAR ON THE HYDRODYNAMIC THEORY ASSOCIATED WITH SHIP MOTION IN WAVES
Paul Kaplan and Jack Kotik [1962] 32 p 43 refs Seminar held in Syosset, N. Y., Aug. 1-19, 1960
(Contract Nonr-3175(00))
(TRG-140-FR)

The problems related to the theoretical calculation of the motion of a ship in waves are discussed. The topics covered include: (1) damping and inertia coefficients for the forced periodic motion of a body at zero speed; (2) the influence of forward speed on these coefficients; (3) cross-coupling terms between different degrees of freedom; (4) forcing functions due to waves incident on a moving ship; and (5) equations of motion, including convolution-type integro-differential equations. Heave and pitch motions were emphasized, and the practical utility of existing and anticipated results was discussed. M.P.G.

N63-12196 Minnesota U. St. Anthony Falls Hydraulic Lab., Minneapolis
TURBULENT BOUNDARY LAYER FLOW OVER A FLAT PLATE VIBRATING WITH TRANSVERSE STANDING WAVES Technical Paper No. 41, Series B

Albert G. Mercer Sept. 1962 48 p 9 refs
(Contract Nonr-710(38))

An attempt is made to show theoretically that the drag caused by a turbulent boundary layer on a smooth flat plate vibrating with low amplitude transverse standing waves is the same as for a nonvibrating plate, provided the wave celerity of the component traveling waves is greater than about 3.5 times the free-stream velocity. Experiments conducted in a water tunnel with a rectangular crossection having one vibrating wall showed no measurable change in boundary-layer velocities, as compared to nonvibrating conditions, for frequencies ranging from 15 to 122 cps and free-stream velocities ranging from 2.4 to 15 fps. The lowest wave celerity to free-stream velocity ratio tested was 2.54. Author

N63-12245 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

A VISUAL STUDY OF A TWO-PHASE FLOW IN A VERTICAL TUBE WITH HEAT ADDITION

Yih Yun Hsu and Robert W. Graham Washington, NASA, Jan. 1963 23 p 14 refs
(NASA TN D-1564) OTS: $0.75

A visual study of two-phase flow with heat addition from the wall has been performed in two glass-tube geometries. The flow regimes of bubbly, slug flow and transition from slug to annular flow were recorded by a high-speed motion-picture camera. Appreciable differences between adiabatic two-phase flow, or two-component flow, and nonadiabatic two-phase flow were observed. These differences emphasize the interaction of the heat transfer and the hydrodynamics in two-phase flow and the inadequacy of adiabatic studies in the accuracy portrayal of the flow model. Author

N63-12253 Arnold Engineering Development Center, Arnold Air Force Station, Tenn.

CHEMICAL KINETIC REGIMES OF HYPERSONIC FLIGHT SIMULATION

Donald J. Harney Jan. 1963 27 p 19 refs
(AEDC-TDR-63-3)

The requirements for hypersonic test facilities are evaluated on the basis of chemical kinetic phenomena. Flight conditions are divided into three broad chemical kinetic regimes, chemical effects negligible, nonequilibrium chemistry, and chemistry in equilibrium. On the basis of this division, it is recommended that a wide class of hypersonic testing, particularly that relating to low-density phenomena, be accomplished without full simulation of flight conditions. Approaches to the simulation of flight in the nonequilibrium regime are suggested, and a brief review of the equilibrium regime indicates that test capability may be limited more from economic rather than technical considerations. Author

N63-12254 Tennessee U., Knoxville

LOW-DENSITY HYPERVELOCITY WIND TUNNEL DIFFUSER PERFORMANCE

M. W. Milligan and J. F. Bailey Arnold Engineering Development Center, Jan. 1963 50 p 90 refs
(Contract AF 40(600)-922)
(AEDC-TDR-63-30)

A complete literature survey has been made in order to establish the current state of wind-tunnel-diffuser technology. Special attention has been given to low-density hypervelocity applications. Such important flow parameters as geometry, boundary-layer flow, real gas effects and rarefied gas effects have been discussed. A series of experimental tests have been recommended which would yield results applicable to predicting diffuser performance in the low-density hypervelocity range. Author

N63-12262 Israel Program for Scientific Translations, Ltd., Jerusalem

GAS DYNAMICS AND PHYSICS OF COMBUSTION A Collection of Articles

R. Hardin and A. S. Predvoditelev (Acad. of Sci. USSR), eds. Jerusalem, 1962 176 p 46 refs Transl. by A. Barouch of book "Gazodinamika i fizika goreniya" Moscow, Izdatel'stvo Akad. Nauk SSSR, 1959
(Published for NASA and NSF)
(NASA TT F-79) OTS: $1.75

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3. PROPAGATION OF WAVES OF FINITE AMPLITUDE GENERATED DURING THE EXPLOSION OF A GAS IN A CYLINDRICAL VESSEL OF VARIABLE VOLUME T. V. Bazhenova (Acad. of Sci. USSR) p 46-52 (See N63-12265 05-26)
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12. INVESTIGATION OF THE COMBUSTION BEHIND A FLAME FRONT IN A TURBULENT STREAM S. A. Gol'denberg, I. N. Sundukov, and V. S. Pelevin (Acad. of Sci. USSR) p 112-138 11 refs (See N63-12274 05-26)
13. THE PROPAGATION OF A TURBULENT FLAME FRONT IN THE PRESENCE OF HIGH FLOW VELOCITIES L. N. Khitrin and S. A. Gol'denberg (Acad. of Sci. USSR) p 139-168 14 refs (See N63-12275 05-26)

N63-12267 Academy of Sciences (USSR). G. M. Krzhizhanovsky Inst. of Power Engineering, Moscow

SOME PROPERTIES OF SUPERSONIC FLOW

V. S. Pushkin *In* Israel Program for Scientific Translations, Ltd., Jerusalem Gas Dynamics and Physics of Combustion 1962 p 66-75 (See N63-12262 05-11) OTS: $1.75

Photographic- and pressure-studies were made of a supersonic flow field near the transition region to determine the phenomena

connected with the instability of a transonic stream. The supersonic flow was obtained by means of linearly divergent rectilinear nozzles with 20°- and 40°-divergence angles. Data were recorded for supersonic streams with boundary-layer pumping and with a wedge placed in the stream in a direction opposite to the flow. Deflection or splitting of the stream was found to occur during pumping out of the boundary layer and could be introduced spontaneously during flow in nozzles of special design. The interaction between the stream and the wedge produced a flow which destroyed the structure of the supersonic stream. R.C.M.

N63-12268 Academy of Sciences (USSR). G. M. Krzhizhanovsky Inst. of Power Engineering, Moscow

SUPERSONIC FLOW IN THE REGION OF AN ANGULAR LEDGE

V. P. Ionov *In* Israel Program for Scientific Translations, Ltd., Jerusalem Gas Dynamics and Physics of Combustion 1962 p 76-81 (See N63-12262 05-11) OTS: $1.75

The flow of a supersonic stream in the region of an angular ledge is studied to determine the interaction between the shock wave and the boundary layer. The flow pattern is examined for Reynolds numbers varying between 10^5 and 10^6 and for both laminar and turbulent boundary layers. The analysis shows that the formation of compression shocks make it possible to evaluate the state of the boundary layer and also the point of transition from the laminar layer to the turbulent one. R.C.M.

N63-12269 Academy of Sciences (USSR). G. M. Krzhizhanovsky Inst. of Power Engineering, Moscow

SUPERSONIC FLOW AT DIFFERENT REYNOLDS NUMBERS IN CONTOURED NOZZLES UNDER CONDITIONS OF OVEREXPANSION

V. P. Ionov *In* Israel Program for Scientific Translations, Ltd., Jerusalem Gas Dynamics and Physics of Combustion 1962 p 82-84 (See N63-12262 05-11) OTS: $1.75

The supersonic jet flow from plane contoured nozzles is studied to determine the variation of flow patterns. Schlieren photographs and static pressure measurements are made under conditions of overexpansion. When the pressure in the stream is lowered, the internal state of the boundary layer changes; and the point of transition from a laminar boundary layer to a turbulent one moves towards the nozzle exit. This increases the interaction between the compression shock and the boundary layer resulting in separation of the boundary layer and the formation of a complex system of λ-shaped shock waves along the nozzle walls. R.C.M.

N63-12270 Academy of Sciences (USSR). G. M. Krzhizhanovsky Inst. of Power Engineering, Moscow

MEASURING THE DENSITY DISTRIBUTION IN A THREE-DIMENSIONAL OBJECT USING THE SCHLIEREN METHOD

T. V. Bazhenova and Z. S. Leont'eva *In* Israel Program for Scientific Translations, Ltd., Jerusalem Gas Dynamics and Physics of Combustion 1962 p 85-91 (See N63-12262 05-11) OTS: $1.75

An approximation method is presented for calculating the temperature and pressure gradients using Schlieren photographs. The method can be used for unsymmetrical objects. The method was proved by measuring the temperature distribution above a heated frame both optically and thermoelectrically. R.C.M.

N63-12271 Academy of Sciences (USSR). G. M. Krzhizhanovsky Inst. of Power Engineering, Moscow

EXPERIMENTAL INVESTIGATION OF THE DENSITY DISTRIBUTION IN A THREE-DIMENSIONAL SUPERSONIC JET

T. V. Bazhenova, Z. S. Leont'eva, and V. S. Pushkin *In* Israel Program for Scientific Translations, Ltd., Jerusalem Gas Dynamics and Physics of Combustion 1962 p 92-94 (See N63-12262 05-11) OTS: $1.75

Density distribution maps are given for two- and three-dimensional jets to compare the method of Pushkin with the method of Bazhenova and Leont'eva. The maps give the lines of equal density in the central section of the jets. R.C.M.

N63-12272 Academy of Sciences (USSR). G. M. Krzhizhanovsky Inst. of Power Engineering, Moscow

THERMOCOUPLE MEASUREMENT OF THE TEMPERATURE IN A HIGH-VELOCITY GAS FLOW

E. V. Kudryavtsev *In* Israel Program for Scientific Translations, Ltd., Jerusalem Gas Dynamics and Physics of Combustion 1962 p 95-103 5 refs (See N63-12262 05-11) OTS: $1.75

The action of a high-velocity gas flow on a thermocouple is analyzed to determine the criteria for efficient design and use of transducers. Formulas are developed to compensate for the effect of heat conduction and radiation at the transducer. These are then applied to the design of transducers for both longitudinal and transverse measurements. The measurement error due to heat loss from the thermocouple junction is reduced to zero in both transducer designs by directing the thermocouple wires along an isotherm. Radiation transfer is eliminated by means of shields and the recovery factor is compensated for by standard calibration curves. R.C.M.

N63-12306 Columbia U., New York, N. Y.

INERTIA TERMS ASSOCIATED WITH SMALL MOTIONS OF A SUBMERGED FLEXIBLE RECTANGULAR CYLINDER

Jacob Lubliner and Hans H. Bleich Nov. 1962 25 p 4 refs (Contract Nonr-266(86))
(Tech. Rept. 30; CU-1-62-ONR-266(86)-CE)

An expression for the kinetic energy of an infinite liquid mass due to small motions of a submerged cylinder is obtained analytically. When the motion is described in terms of generalized coordinates, the corresponding inertia coefficients appear in the kinetic-energy expression. The analysis is carried out for the problem of a floating, flexible rectangular box. Calculations are performed for generalized coordinates representing rigid-body motion and plastic deformation. Author

N63-12307 Columbia U., New York, N. Y.

IMPACT ON THE SURFACE OF A COMPRESSIBLE FLUID

Richard Skalak and David Feit Jan. 1963 34 p 12 refs (Contract Nonr-266(86))
(Tech. Rept. 31; CU-1-63-ONR-266(86)-CE)

The pressure field generated by the impact of a rigid or flexible body on the surface of an inviscid, compressible fluid is considered. Some general results for the forces generated by the impact are given. Pressure distributions for rigid wedges are computed from known analagous solutions of linearized supersonic airfoil theory. In the impact problem, the transition from compressible to incompressible behavior is demonstrated as the velocity of impact is reduced. Author

N63-12313 Vidya, Inc., Palo Alto, Calif.

INVESTIGATION OF HYPERSONIC FLOW SEPARATION AND ITS EFFECT ON AERODYNAMIC CHARACTERISTICS Preliminary Report

Jack N. Nielsen and Frederick K. Goodwin Jan. 1962 70 p 109 refs
(Contract AF 33(657)-7084)
(Vidya Rept.-63)

Hypersonic flow separation and its effect on aerodynamic control characteristics were investigated. Analytical and experimental data were surveyed. Calculations were performed to determine typical conditions at the edge of the boundary layer on a vehicle entering the earth's atmosphere. Results of these calculations were compared with the conditions to be obtained on the models to be tested in the University of California wind tunnel. From this comparison, it was found that it is possible to simulate in the tunnel the freestream

Reynolds number over a good portion of the chosen trajectory. It is possible to simulate the Mach number at the edge of the boundary layer and also the ratio of wall temperature to recovery temperature. I.v.L.

N63-12320 Georgia Inst. of Tech. School of Mechanical Engineering, Atlanta

VISCOUS COMPRESSIBLE FLUID FLOW UNDER THE INFLUENCE OF A RESONANT ACOUSTIC FIELD

Kenneth R. Purdy and Thomas W. Jackson Wright-Patterson AFB, Ohio, Aeronautical Research Labs., Oct. 1962 52 p 9 refs
(Contract AF 33(616)-8396)
(ARL-62-457)

An analytical solution is presented for low Mach number viscous compressible channel flow under the influence of a resonant acoustic field. The solution predicts the existence of standing vortices in the flow, and that the ratio of the maximum width of the vortices to the half-width of the channel is solely a function of the parameter $\bar{M}/M_0^2$, where $\bar{M}$ is the Mach number based on the average through flow velocity and M_0 is the acoustic Mach number based on the maximum amplitude of the time-dependent velocity. The order of magnitude analysis which was used to reduce the equations of motion required that $\bar{M}/M_0^2$ should be less than approximately ten. The existence of standing vortices was confirmed experimentally by a visualization study of tube flow. Typical flow fields are shown both graphically and photographically. Finally, the threshold data of Eastwood for convective heat transfer under the influence of a resonant acoustic field are correlated for the range of tube diameter Reynolds numbers between 11,000 and 33,000. It was shown for this case that sound affects the local heat-transfer rate when $\bar{M}/M_0^2$ is less than 63. Author

N63-12346 Grumman Aircraft Engineering Corp., Bethpage, N. Y.

ANALYSIS OF A SKIMMER FOR A HIGH-INTENSITY MOLECULAR BEAM USING A THREE-FLUID MODEL

Richard A. Oman Oct. 1962 14 p 2 refs
(NASA Contract NASr-104)
(RM-214) OTS: $1.10 ph, $0.80 mf

An approximate technique for calculating the effects of molecular collisions in near-free-molecule flow over complex geometries is applied to the analysis of a skimmer for a high-intensity molecular beam. The method involves a calculation of the scattering losses due to molecules reflected from external surfaces, and the additional losses due to collisions with the products of the primary scattering. This model allows for the internal choking effects which are known to occur in low-density flow passages. Numerical results are presented for a conical inlet with a semitoroidal lip in an infinite speed ratio stream. Author

N63-12348 Bureau d'Analyse et de Recherche Appliqueés, Issy-les-Moulineaux (France)

ANALOG STUDY OF SOME PROBLEMS RELATIVE TO LIFTING SURFACES IN AN HELICOIDAL MOVEMENT Final Report

[1962] 32 p 3 refs
(Contract N62558-2997)

An analog tank is used to study three-bladed propellers. The wake of a three-bladed propeller is analyzed to determine an analog model for predicting the profile with various blade parameters. Pressure distributions for blades, having circular sector projection, and for elliptic blades, obtained with the analog tank, check with values obtained with Jones' theory. A camber correction coefficient is derived for comparing blades of various expanded blade area ratios. R.C.M.

12 GEOPHYSICS

Includes: auroral phenomena; upper atmospheric studies; cartography; geodesy; and geomagnetism.

For Van Allen belts see: 28 Space Radiation.

For related information see: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N63-11951 Alaska U. Geophysical Inst., College

THE MAGNETIC FIELD OF THE RADIATION BELTS

Joseph C. Cain (NASA. Goddard Space Flight Center) and Syun-Ichi Akasofu Repr. from J. Geophys. Research, v. 67, no. 10, Sept. 1962 p 4078-4080 5 refs
(NASA Grant NsG 201-62)

The magnetic fields produced by belts of trapped particles are presented in graphical form. The ring current field ΔF is given in gammas where Δf in gamma cm^3 kev is shown as a function of equatorial radial distance. The graphs are drawn for various sets of r_o, g_1, g_2, and α as an aid in estimating the distortion of the earth's field for actually observed belts. R.C.M.

N63-11980 National Bureau of Standards, Boulder, Colo.

PROFILES OF ELECTRON DENSITY OVER THE MAGNETIC EQUATOR OBTAINED USING THE INCOHERENT SCATTER TECHNIQUE

K. L. Bowles et al Dec. 18, 1962 35 p 2 refs
(NBS-7633; NBS-TN-169)

Electron density profiles (obtained near Lima, Peru), using the incoherent scatter measurement technique of Bowles et al. (1962), are presented. Profiles reported were obtained with the radar antenna directed three degrees away from the perpendicular. Under this arrangement, the coherent echo power should be reduced perhaps three to four orders of magnitude relative to the perpendicular. Coherent irregularities are, therefore, ignored for analysis of most of the profiles. Transmitter peak power and antenna cross-section values are given for the months January, February, and April of 1962. The profiles obtained are reliable up to 200 km, but the electron densities indicated below that height are overestimated. I.v.L.

N63-12028 Rensselaer Polytechnic Inst., Troy, N.Y.

EFFECTS OF THE ATMOSPHERE ON RADIO ASTRONOMICAL SIGNALS Final Report

Robert Fleischer, Masakazu Oshima, Terry P. Roark, Ronald M. Straka, and Marvin De Jong April 30, 1962 60 p 20 refs
(Contract AF 19(604)-8055)
(AFCRL-62-311)

Observations of the apparent temperature of thunderstorm cells were made at a number of frequencies, from 10 cps to 3000 mc during the month of July 1961. The storm July 21 is analyzed in detail. The observations are summarized. A theory is developed to predict the antenna temperature T_λ which may be expected from a storm cell. The calculations of the observed antenna temperature at several frequencies are given, and limits are put on the parameters of the discharge model to fit the observations. A discussion is given of the extent of agreement of theory and observation with some suggestions for further detail in investigation. Author

N63-12060 California U., Livermore. Lawrence Radiation Lab.

A SELF-CONSISTENT DISTRIBUTION OF ELECTRONS IN THE ASTRON E-LAYER

Warren Heckrotte and Kelvin Neil June 8, 1962 23 p 7 refs
(Contract W-7405-eng-48)
(UCRL-6942) OTS: $0.50

In this calculation the E-layer is assumed to be of zero thickness, uniform radius, and finite length. The electrons are relativistic with a unique canonical angular momentum, and the layer is charge-neutralized. The magnetic-field configuration and the self-consistent electron distribution in phase space are calculated. Results indicate that the layer is stable against the axial bunching instability. The layer is stable against the $B\theta$ instability until the magnetic-self field is 20% greater than that necessary for field reversal. The problem of providing the time-dependent external field required to insure the desired layer properties is defined. Author

N63-12137 Aerospace Information Div., Library of Congress, Washington, D. C.

MAGNETIC AND ELECTRICAL PHENOMENA IN OCEANS AND SEAS

Jan. 11, 1963 3 p Review of: V. V. Shuleykin Ocherki po fizike morya (Studies on marine physics), Moscow, Izd-vo Akad. Nauk SSSR, 1962 p 410-466

(AID-S-63-4) OTS: $1.10 ph, $0.80 mf

A summary of research is presented on geomagnetism and geoelectricity as they occur in oceans and seas. Emphasized was the submerging of compasses in specially designed housings into deep oceanic waters to study actual changes in the magnetic field as a function of the depth. Probings verified the hypothesis that the magnetic field of telluric currents in the ocean helps to create a latitudinal component of the intensity of the geomagnetic field, i.e., of the magnetic declination. On the basis of data obtained, it may be assumed that about one-half of the latitudinal component is generated by telluric currents in the ocean. I.v.L.

N63-12144 Michigan U. Coll. of Engineering, Ann Arbor

THEORY AND IMPLEMENTATION OF THE PITOT-STATIC TECHNIQUE FOR UPPER ATMOSPHERIC MEASUREMENTS

J. J. Horvath, R. W. Simmons, and L. H. Brace Mar. 1962 42 p 1 refs

(NASA Contract NASr-54(01); AF 19(604)-6124; ORA Proj. 04673 and 03554)

(Scientific Rept. NS-1) OTS: $4.60 ph, $1.46 mf

The pertinent characteristics of the grenade, sodium vapor, falling sphere, and pitot-static atmospheric measurement techniques are outlined. The pitot-static probe being implemented by investigators at The University of Michigan is described and the theory is discussed. The results of a test launching in October 1960 are presented to demonstrate the use of the pitot-static technique. It is concluded that the accuracy and versatility of the pitot-static probe and portability of its associated ground support system make it an extremely useful tool for the measurement of pressure, temperature, density, and winds up to 120 km in the earth's atmosphere, particularly at remote sites where other techniques are not feasible. Author

N63-12148 Chicago U. Weather Forecasting Research Center, Ill.

ON THE PLACEMENT OF THE TROPOPAUSE IN THE ANTARCTIC Scientific Report No. 9

Ronald Overby Dec. 1962 52 p 19 refs

(Contract AF 19(604)-7230)

(AFCRL-62-1134)

Several investigations have led to the conclusion that there is a definite difference between the arctic and the antarctic tropopause. Using the standard definition of tropopause, the average height and temperature values for the arctic tropopause for winter are 320 mb. and -52° C, and for summer they are 260 mb. and -56° C. The average values for the antarctic tropopause are reversed, with higher and colder values in winter, 230 mb. and -70° C, and lower and warmer values in summer, 300 mb. and -50° C. Because of the low stratospheric temperatures in the winter, the antarctic tropopause sometimes completely disappears. It was thought that, by applying a new definition to determine the placement of the tropopause, a reversal of the seasonal fluctuations of the antarctic tropopause might be indicated. This was not proven for the 14-month period used for this study, but the mean height of the tropopause was lowered, the greatest change taking place during the winter season. The number of cases which indicated no tropopause under the conventional definition was reduced when the new definition was applied. Author

N63-12159 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE IMPEDANCE OF AN ELECTRICALLY SHORT ANTENNA IN THE IONOSPHERE

H. A. Whale Washington, NASA, Jan. 1963 11 p 4 refs Presented at The Inst. of Phys. and The Phys. Soc. Conf. on "The Ionosphere", London, July 1962

(NASA TN D-1546) OTS: $0.50

Measurements from rocket flights are used to show that the impedance of a short antenna operating above the local plasma frequency can be predicted if the following factors are considered: (1) the formation of an ion sheath around the antenna and the vehicle, (2) the enhancement of this sheath when large RF voltages are applied to the antenna, and (3) the loading that apparently arises from electroacoustic waves excited in the medium by the RF field close to the antenna. Sufficient design data are included to calculate the effect of the ionosphere on both the resistive and reactive parts of the impedance of a short antenna. Author

N63-12198 Alaska U. Geophysical Inst., College

INTERPRETATIONS OF THE TIME VARIATIONS OF POLAR CAP ABSORPTION ASSOCIATED WITH SOLAR COSMIC RAY BOMBARDMENTS Scientific Report No. 3

H. Leinbach May 1962 245 p 96 refs

(NSF Grant G-14133)

(UAG-R127)

Interpretations of the time variations of the polar cap absorption, associated with solar cosmic ray bombardments, were investigated using riometer data on the nature of the interplanetary propagation and storage of the energetic solar particles; and the influence of the earth's magnetic field on the bombarding solar particles. I.v.L.

N63-12290 Michigan U. College of Engineering, Ann Arbor

STUDY OF THE ROCKET-SOUNDING METHODS OF MEASURING THE UPPER ATMOSPHERE. (SOME GAS KINETIC PROBLEMS PERTAINING TO THE UPPER ATMOSPHERIC MEASUREMENTS) Final Report [Mar. 1959-June 1962]

V. C. Liu Aug. 1962 166 p 11 refs

(Contract AF 19(604)-5477)

(AFCRL-62-1021)

The report aims at resolving some rarefied gas dynamical problems pertaining to atmosphere measurements by means of satellites and sounding rockets. Specific problems treated are the following: Sphere drag in semirarefied gas (often called transition flows), electrohydrodynamic interaction of ionosphere with a moving body, propagation of sound in a rarefied gas under external force field, and rarefied gas dynamical considerations of sounding measurements of upper atmosphere. The report also includes several basic problems of possible geophysical interest. Specific recommendation is made in regard to coordinating the geophysical experiment and gas dynamical studies in the free-flight measurements. Author

N63-12298 Illinois U. Electrical Engineering Research Lab., Urbana

A STUDY OF PROCESSES IN THE IONOSPHERE BY MEANS OF GYROINTERACTION EXPERIMENTS CARRIED OUT WITH ROCKETS Final Report, 1 June 1959 to 30 April 1962

R. R. Hodges, K. G. Balmain, Georges A. Deschamps, and J. T. Verdeyen Aug. 1962 120 p 58 refs
(Contract AF 19(604)-5565)
(AFCRL-62-1071)

Processes in the ionosphere were investigated by means of gyro-interaction carried out with rockets. Results were as follows: (1) Cross modulation of a sensing wave due to electron heating in the E layer was measured by means of telemetered data obtained from a gyro-resonance probe. In addition, it was demonstrated that there is an anisotropy in the 45-km to 70-km region of the ionosphere which can be detected by two new methods: the change of axial ratio of the sensing wave polarization ellipse with altitude, and the modulation of the rotation of the sensing wave with electron heating. (2) A quasi-static theory for the field and impedance of a short dipole antenna has been worked out. Laboratory impedance measurements for a probe in an anisotropic plasma agree fairly well with the theory, especially for the case of a moderate to high magnetic field. The formation of the ion sheath has been studied and conditions for its collapse have been obtained (using positive bias). I.v.L.

N63-12349 Bureau of Mines. Applied Physics Research Lab., College Park, Md.
VIBRATIONS FROM INSTANTANEOUS AND MILLISECOND-DELAYED QUARRY BLASTS
Wilbur I. Duvall, Charles F. Johnson, Alfred V. C. Meyer, and James F. Devine 1963 39 p 27 refs
(BM-RI-6151)

Nineteen quarry blasts were instrumented with particle-velocity gages mounted in a uniform soil overburden, back of one face in a quarry in Iowa. Three components of particle velocity, radial, vertical, and transverse, were recorded at each of eight stations back of each blast. Distances from blast area to gage stations ranged from 150 to 3,000 feet. Eleven of the quarry blasts employed millisecond delays, and eight were instantaneous blasts. Charge weight per hole was 200 pounds, and the charge weight per delay interval, including the instantaneous blasts, ranged from 100 to 3,000 pounds. Analysis of the data from these tests shows that the particle velocity, V, produced at distance, D, by a quarry blast of charge per delay interval, W, can be represented by an equation of the form,

$$V = K W^{b} D^{-n},$$

where b and n are exponents, and K is the intercept constant which is a measure of the level of vibration. The value of K for a millisecond-delayed blast employing one hole per delay interval is about 42 percent larger than the value of K for a single-hole blast. The value of K for a multiple-hole millisecond-delayed blast is about the same as that for an instantaneous blast when the charge per delay for the millisecond blast is equal to the total charge for the instantaneous blast. The vibration level from millisecond-delayed blasts employing one hole per delay is shown to be independent of the length of the delay interval and the number of delay intervals over the range of the variables tested: 9, 17, and 34 milliseconds and 3, 7, and 15 delays per blast. Author

13 HEAT TRANSFER

Includes: ablation; cooling; heating; and other thermal effects.

For aerothermodynamics see: 02 Aerodynamics . of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings and Control Surfaces.

For combustion see: 26 Propellants and Combustion.

For related information see: 11 Fluid Mechanics.

N63-11984 Los Alamos Scientific Lab., N. Mex.
A PARAMETRIC SURVEY OF TUBE AND FIN TYPE RADIATORS
R. C. Anderson and B. J. Henderson Jan. 2, 1963 42 p 4 refs
(Contract W-7405-eng-36)
(LAMS-2793) OTS: $1.00

This report describes the methods employed and the results obtained in a parametric survey, for space applications, of the characteristics of radiators to be used in dumping excess heat from reactors. Author

N63-12087 Aerospace Corp. Aerodynamics and Propulsion Research Lab., El Segundo, Calif.
GENERAL RESEARCH: NONEQUILIBRIUM-DISSOCIATED STAGNATION POINT BOUNDARY LAYERS WITH ARBITRARY SURFACE CATALYCITY
George R. Inger Jan. 14, 1963 44 p 36 refs
(ATN-63(9206)-3)

An approximate theory of nonequilibrium stagnation-point boundary layers on highly cooled blunt bodies in hypersonic flow, including a finite atom recombination rate on the surface, is presented. Simple, closed form solutions for surface properties, such as atom concentration on the wall and heat transfer, are obtained with arbitrary rates of homogeneous and heterogeneous reaction. The results are expressed in a universal form involving a single, composite Dahmkohler number that accounts for the simultaneous effects of gas phase and surface recombination over a wide range of the various theromochemical parameters involved. The theory is based on a simplified analytical representation of the net dissociation-recombination rate distribution. This representation, which retains the essential nonlinear features of the homogeneous reaction rate, is derived from the fact that the nonequilibrium boundary layer behavior is dominated by the effect of recombination near the wall when the wall is highly cooled. The resulting solutions are supported by exact solutions obtained in the limiting case of nearly-frozen flow and are also in good agreement with the numerical results for nonequilibrium flow reported by Fay and Riddell. Author

N63-12108 Massachusetts Inst. of Tech., Cambridge
THE IRRADIATION OF SANTOWAX OMP IN THE M.I.T. IN-PILE LOOP. PART I. SUMMARY TO OCTOBER 5, 1961
D. T. Morgan and E. A. Mason Washington, AEC Div. of Tech. Information, May 1962 169 p 22 refs For Pt. II see N63-12130 05-13
(Contract AT(10-1)-1067)
(MITNE-21) OTS: $2.75

An operational in-pile loop in the M.I.T. nuclear reactor is now available for testing organic materials suitable for use as moderator-coolants in nuclear reactors. The first in-pile irradiation using Santowax OMP as the test material was started on August 9, 1961. The physical and chemical properties of the irradiated Santowax OMP are presented, covering the irradiation period up to October 5, 1961. During this period, the concentration of radiolytic degradation products in the coolant increased from ~0 to 39 wt%. Forced convection heat transfer measurements were made throughout the irradiation period, and correlations of the data are presented. The use of Wilson's method for the study of fouling is also discussed and illustrated, using the heat transfer data. Extensive calorimetric measurements of the dose rate in the position occupied by the in-pile section of the loop have been made, using a special adiabatic calorimetric developed for this purpose. Based on these dose rate measurements and the measure concentrations of each terphenyl isomer in the coolant (ortho-, meta-, and para-) in this experiment, the decomposition yields have been found to be:

$$G^{*}(-i) = \frac{G(-i)}{C} = 0.28 \pm 0.03 \ \frac{\text{molecules of component i degraded/100 ev absorbed}}{\text{wt fraction of component i}}$$

for each of the terphenyl isomers. G*(-i) is not significantly affected by the concentration of degradation products. This, as well as the

other results of this investigation, to date, have generally been similar to those reported previously for Santowax R at the same temperature and thus generally support the reactor design studies that have been reported to date. Author

N63-12111 Solar, San Diego, Calif.
DEVELOPMENT OF MANUFACTURING METHODS FOR LIGHTWEIGHT METAL FOIL HEAT EXCHANGERS Interim Technical Report [No. 2, 18 September 1962-17 December 1962]
L. A. Schlagel and Merrill P. Rope [1962] 82 p 6 refs
(Contract AF 33(657)-8766)

Activities were planned to produce information that is required for the final heat exchanger designs. Activities were as follows: (1) Modifications were made to various tools to experimentally develop the best methods for forming and joining metal foil materials. (2) Experimental test samples were subjected to pressurization tests to evaluate the strength of the bonds and the design limitations. (3) Improvements to the heat exchanger designs have resulted from analysis of the experimental work in forming, joining, and pressure testing. (4) The literature survey and study of materials and coatings suitable for high temperature heat exchanger construction were completed. (5) Analytical work was initiated to support the final designs for the heat exchanger ducting transitions, and manifolds. Author

N63-12126 General Electric Co. Space Sciences Lab., Philadelphia, Pa.
THE HYPERSONIC ENVIRONMENT — HEAT TRANSFER IN MULTICOMPONENT GASES
Sinclaire M. Scala Dec. 1962 59 p 110 refs Submitted for Publication
(R62SD987)

The prediction of heat transfer in the high temperature hypersonic flight regime continues to be a challenging problem, particularly with the increasing need to understand the phenomena from a microscopic viewpoint. In this review paper, the general hypersonic heat-transfer problem, for an arbitrary planetary atmosphere, is introduced by classifying the various regimes of interest. Recent developments in each of these regimes, ranging through the free molecule, near free molecule, low Reynolds number and high Reynolds number regimes are considered. Some of the latest techniques for predicting aerodynamic and radiative heat transfer are discussed, and uncertainties are pointed out. Throughout the paper, special emphasis has been placed on a discussion of thermophysical phenomena, which points out the need for the introduction of classical, statistical and quantum mechanical approaches to the development of realistic models for the hypersonic interaction problem. Author

N63-12130 Massachusetts Inst. of Tech., Cambridge
THE IRRADIATION OF SANTOWAX OMP IN THE M.I.T. IN-PILE LOOP PART II. EQUIPMENT DESIGN, PROCEDURES AND RESULTS OF IRRADIATION TO OCTOBER 5, 1961, BOOK I and BOOK II
D. T. Morgan and E. A. Mason Washington, AEC Div. of Tech. Information, May 1962 647 p 100 refs In 2 vols. For Pt. I and abstract see N63-12108 05-13
(Contract AT(10-1)-1067)
(MITNE-22(Bk. I); MITNE-22(Bk. II)) OTS: $7.50

14 HUMAN BEHAVIOR

Includes: crew training and evaluation; piloting; psychological factors.

For simulators see: 10 Facilities.

For related information see: 16 Life Sciences.

N63-12038 Douglas Aircraft Co., Inc. El Segundo Div., Calif.
AN INVESTIGATION OF THE EFFECTS OF PULSED LIGHTING UPON AIRCRAFT DISPLAYS RELATIVE TO THE PRESERVATION OF DARK ADAPTATION FOR NIGHT FLYING
L. R. Uyeda and B. H. Levedahl July 18, 1962 41 p 15 refs
(Contract Nonr 1076(00))
(LB-30977)

The relationship of pulsed and continuous lighting upon a compensatory task, and its subsequent effect on scotopic detection performance was examined under two levels of illumination. Response latency of detecting Landolt rings, as well as the number of detection errors incurred, was an index of the time required to effectively regain dark adaptation. On the basis of the results obtained, it is concluded that dark adaptation may be preserved if the visual display is illuminated with pulsed lighting in the frequency range of 5 to 15 cps. In this condition, the experimental vehicular tracking performance appears unimpaired. Author

N63-12248 Federal Aviation Agency. Civil Aeromedical Research Inst., Oklahoma City, Okla.
ABSOLUTE IDENTIFICATIONS OF CUTANEOUS STIMULI VARYING IN BOTH INTENSITY LEVEL AND DURATION
Glenn R. Hawkes Sept. 1962 8 p 11 refs
(CARI-62-16)

The number of possible absolute identifications of electrical cutaneous stimuli varying in both stridence and duration was investigated for both experienced and naive Os. In some sessions, an equal number of stridencies and durations were used; in others there were more stridence levels than durations or the reverse. Maximum transmission of information was with combinations of four stridence levels and four durations. The channel capacity was about 2.97 bits for the experienced Os and 2.76 bits for the naive ones. Experience was not a statistically significant factor when an equal number of durations and stridence levels was used. In sessions with unequal numbers of durations or stridencies, experienced Os transmitted significantly more information and both groups were more efficient when identifying combinations with more durations than stridence levels. Experienced Os identifying stimuli varying in stridence or duration under conditions comparable to those of the present study have been reported to transmit about 1.45 to 1.7 bits in each of these (unidimensional) situations. The value of 2.97 bits of this study was just a little less than the simple sum of the performances obtained with the dimensions used singly, but it was also apparent that the dimensions are not fully interchangeable. Author

N63-12332 Aerospace Medical Center. School of Aerospace Medicine, Brooks AFB, Tex.
PREDICTION OF SPEECH DISCRIMINATION SCORES FROM OTHER TEST INFORMATION
Lois L. Elliott Dec. 1962 16 p 4 refs
(SAM-TDR-62-145)

This study attempted to predict discrimination scores by using other audiometric test information. For two samples tested with Rush Hughes materials and one sample tested with W-22 materials, PB score in the nontest ear and difference between SRT's in the test and nontest ears were the two best predictors of PB scores. The estimating equation (Rush Hughes) developed on these samples was applied to groups with normal hearing (very poor prediction) and mixed losses (moderately good prediction). Application of the equations to cross-validation samples indicated high validity coefficients for the W-22 equation, but only moderate validity coefficients for the RH equation. Results suggest that the predictive contribution of PB score in the nontest ear includes the effect of nonmeasured variables such as subject's verbal aptitude, motivation, and difference between speaker's and listener's dialects. Author

15 INSTRUMENTATION

Includes: design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; and sensors and transducers.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N63-11954 Bendix Corp. Friez Instrument Div., Baltimore, Md.
DEVELOPMENT OF A ROCKETSONDE INSTRUMENT PACKAGE FOR HIGH ALTITUDE METEOROLOGICAL SOUNDING Final Report
J. H. Stoudenmire, R. T. Mc Coy, and D. R. Greene Dec. 1962 45 p 13 refs
(Contract AF 19(604)-8433)
(AFCRL-62-875)

The development of the Bendix Friez rocket instrument package for use with Rawin Set AN/GMD-2 in high-altitude meteorological soundings is described. The primary function of the instrument package (or sonde) is the measurement of atmospheric temperatures as it descends by parachute from apogee, transmitting this data simultaneously with ranging information on a standard radiosonde carrier frequency. The report includes design considerations, descriptions of the package's electronic system and structure, discussion of associated thermistor development, results of environmental tests, and recommendations for additional developmental work. Author

N63-11955 Bell Helicopter Co., Fort Worth, Tex.
SIMULATION EVALUATION OF A HEAD MOUNTED ORIENTATION DISPLAY
W. E. Feddersen May 1962 29 p 8 refs
(Contract Nonr 1670(00))
(D228-421-012)

This report summarizes the procedures and results of a study to determine the effect upon hovering performance of angular differences between head position and field of view, as presented by a helmet-mounted contact analog display. The results, as presented in terms of integrated absolute ground-position error scores, indicated that pretest performance on a panel-mounted contact analog display was superior to that exhibited by the subjects on the helmet-mounted display. The former system was near optimum in terms of resolution, clarity, comfort, and subject experience. When performing with the helmet-mounted display, the subjects' performance deteriorated, but the deterioration was distributed across all conditions of head position and field of view and was not restricted to any particular head orientation. As determined by a standard nonparametric test, none of the performance differences between left- and right-hand position were significant when compared with the condition in which the forward-looking display view coincided with the orientation of the head. Author

N63-11961 Bureau of Mines. Bartlesville Petroleum Research Center, Okla.
AN INCLINED-PISTON DEADWEIGHT PRESSURE GAGE
D[onald] R. Douslin and J. P. McCullough 1963 15 p 12 refs
(BM-RI-6149)

This report describes an inclined-piston pressure gage that operates from a zero-pressure datum level. The gage is adaptable to accurate vapor-pressure measurements in the low and intermediate pressure range, 0.01 to 40 mm (mercury). Residual friction in the oil-lubricated piston-cylinder combination is eliminated by a unique oscillatory method that is free of end thrust on the piston and allows the full sensitivity of the gage to be realized. The axial component of the weight-to-area ratio of the piston is determined by measuring the angle of inclination with a goniometer that can be read to 1 sec. Accuracy of the gage proper is estimated to range from 0.001 to 0.012 mm from lower to upper-pressure limits. Its highest practical sensitivity is about 0.0005 mm. As a test, the vapor pressures of ice and water were measured in the range −30° to +20° C. Author

N63-11976 Hanford Atomic Products Operation, Richland, Wash.
A COINCIDENCE COUNT ALPHA PARTICULATE AIR MONITOR
D. P. Brown, M. O. Rankin, C. D. Boyne, and W. G. Spear Jan. 3, 1963 23 p 7 refs
(Contract AT(45-1)-1350)
(HW-75384) OTS: $0.50

An alpha monitor for the detection of airborne plutonium was developed and tested satisfactorily. The measured plutonium alpha detection sensitivity is 15 maximum permissible concentration (MPC) hours; that is, a continuous alpha air concentration of 2×10^{-13} μc/cc (one MPC for a 40 hour week) can be detected with consequent alarm energizing after a 15-hour collection period. This sensitivity can be attained even under extreme natural alpha emitter (radon-thoron concentration conditions of 2×10^{-10} μc/cc. The time-to-alarm or inherent sensitivity is linearly related to the continuous plutonium air concentrations in that 2×10^{-11} μc/cc causes alarm in 1.5 hours, and 2×10^{-10} μc/cc (100 MPC) causes alarm in 9 minutes. Author

N63-11978 Guggenheim Labs. for the Aerospace Propulsion Sciences, Princeton U., N. J.
SENSITIVITY ANALYSIS FOR THE CALORIMETRIC PROBE
Jerry Grey Dec. 1962 17 p 2 refs
(Contract AF 33(657)-9962)
(Aeronautical Eng. Lab. Rept. 633)

An approximate method for estimating the sensitivity of the calorimetric probe under different conditions of operation has been developed. Comparison of the results with measured sensitivities indicated appreciable scatter, but was adequate to confirm the general approach. Author

N63-11985 Los Alamos Scientific Lab., N. Mex.
AN ABSOLUTE MASS RATE FLOWMETER
F. A. Guevara, R. M. Potter, and W. E. Wageman Jan. 8, 1963 14 p 3 refs
(Contract W-7405-eng-36)
(LA-2812) OTS: $0.50

A true mass-flow-rate device has been developed that is absolute in the sense that it requires no calibration. The flow measurement is made by adding a known amount of energy to a gas and finding its resulting temperature increase. The flowmeter is essentially pressure independent and is capable of 0.1% reproducibility. It is suggested that other versions of this flowmeter should be practical over wide ranges of pressure and temperature and should be usable with a variety of gases and liquids. Author

N63-12018 Joint Publications Research Service, Washington, D.C.
CERTAIN QUESTIONS IN THE HISTORY OF THE DEVELOPMENT OF AIRCRAFT INSTRUMENTS, THEIR PARTS AND ELEMENTS
G. A. Slomyanskiy Jan. 23, 1963 20 p Transl. of article from Tr. Mosk. Aviats. Tekhnol. Inst. (Moscow), no. 52, 1961 p 20-28
(JPRS-17257) OTS: $1.60

Soviet efforts in the theory and design of aircraft instruments are documented. Areas for future development of Soviet aircraft instrumentation are as follows: perfection of automatic-control devices, creation of new types of integral and combined instruments with a graphic indication system, and increasing the accuracy and reliability of instruments but decreasing their dimensions and weight. D.B.

N63-12039 Aerospace Corp. Physical Research Lab., El Segundo, Calif.

A MAGNETOHYDRODYNAMIC FLOW ANGLE INDICATOR

A. E. Fuhs and O. L. Gibb Nov. 13, 1962 20 p 5 refs
(Contract AF 04(695)-169)
(TDR-169(3153)TN-4; BSD-TDR-62-318)

By using the directional sensitivity of the electrical conductivity instrument, it is possible to measure the direction of the flow of a conducting gas. If only one coil set is used, a complex calibration procedure is necessary; however, by using two coil sets, the flow angle becomes a function only of the ratio of two signals. It is shown theoretically, and verified experimentally, that the signal varies as the cosine of the flow angle. The flow angle can be expressed analytically as a function of signal ratio. Calculated and observed signal ratios are in agreement. The precision of measurement is ± (1 deg. + 5%) for flow angles of +45 to –45 degrees. Author

N63-12046 California Inst. of Tech. Seismological Lab., Pasadena

BRIEF DESCRIPTION OF RANGER LUNAR SEISMOGRAPH

F. E. Lehner Repr. from Proc. IRE, v. 50, no. 11, Nov. 1962 1 p 2 refs
(NASA Contract NASw-81)
(Its Contrib. 1089)

It is hoped that before long the United States will safely land a Ranger instrument package containing a seismometer on the Moon. Waves from moonquakers, if they occur, and meteoric impacts will be detected, telemetered to earth, and registered for study. From the seismograms may be deduced information concerning the moon's near surface and interior structure. This paper is an abbreviated description of instrumentation for the experiment. Author

N63-12068 Illinois U. Electrical Engineering Research Lab., Urbana

A NUCLEAR MAGNETOMETER

B. J. Flaherty and G. W. Swenson, Jr. Nov. 15, 1962 19 p 7 refs
(NASA Grant NsG 24-59)

A simple proton-precession magnetometer is developed that gives an absolute measure of the earth's magnetic field with an accuracy better than ±2γ. Basically, the device consists of a quart jar of distilled water with approximately 1500 turns of #18 Nyclad wire that form a multilayer solenoid coil around it; this is enclosed in a brass box large enough not to affect the Q of the coil. The instrument operates on the principle that the hydrogen protons in the liquid sample located in the earth's magnetic field, F, when subjected for several seconds to a d.c. field much larger than F, will be polarized along the direction of the field, H. When the H field is suddenly removed by cutting off the d.c. source, the protons precess along the earth's field, F, before becoming aligned with it. This proton precession induces an a.c. voltage in the coil at the precession frequency, which can be measured to give the value of F. Circuit diagrams, construction notes, accuracy analyses, and sample recordings made with this instrument are included. M.P.G.

N63-12099 Cryogenic Engineering Lab., National Bureau of Standards, Boulder, Colo.

SURVEY OF CRYOGENIC INSTRUMENTATION—SUPPLEMENT NUMBER ONE

May 1, 1962 63 p 59 refs For original report, see N62-11342 05-21
(NASA Order R-13)
OTS: $6.60 ph, $2.09 mf

N63-12104 Aerospace Corp. Physical Research Lab., El Segundo, Calif.

A SURVEY OF DIAGNOSTIC METHODS FOR IONIZED GASES USING MAGNETIC FIELDS

R. Betchov and A. E. Fuhs Sept. 21, 1962 27 p 7 refs
(Contract AF 04(695)-169)
(TDR-169(3153)TR-1; BSD-TDR-62-237)

This report describes a number of instruments designed to probe the plasma sheet during reentry or any other plasma flow. The instruments produce magnetic fields and respond to the currents induced in the plasma as it cuts through the magnetic field. The set of instruments can measure: an averaged value of the product of conductivity times velocity, a profile of the same product, the local flow direction, an averaged flow velocity, and certain turbulent fluctuations. Another instrument, now being developed, will measure an average value of the electron-neutral collision frequency. Flight instruments and laboratory instruments are briefly described. Calibration procedures are outlined. Author

N63-12172 Union Carbide Nuclear Co., Oak Ridge, Tenn.

AUTOMATIC MASS SPECTROMETER FOR MONITORING URANIUM ISOTOPE CONCENTRATIONS

A. Langdon, E. C. Evans, and C. D. Tabor Jan. 23, 1963 19 p 4 refs
(Contract W-7405-eng-26)
(K-1445) OTS: $0.50

An automatic recording mass spectrometer has been designed; two instruments have been constructed and have operated reliably for more than seven years as process monitors. Each is fully automatic and capable of making a uranium isotope determination every two and one-half minutes. The results are recorded directly in weight percent U^{235} with a precision equivalent to that obtained with a manually operated instrument. Provisions have been made to transmit the results to a "slave" recorder and a valve controlling the process. The instruments are of relatively simple circuitry, and require no reference standards. Author

N63-12206 Pennsylvania State U., University Park

A VERSATILE FIELD ION MICROSCOPE Technical Report

S. B. Mc Lane, Jr., and E. W. Müller Dec. 1962 26 p 6 refs
(Contract Nonr-656(23))

An all metal design of the field ion microscope has proven to be both feasible and versatile. Adaptability, variable magnification, ruggedness, greater safety when used with liquid-hydrogen cooling, and high-voltage shielding characterize this model. A 6-inch-diameter vertical screen, which is easily replaceable, facilitates its use. Application of this model to the study of different screen materials, the use of solid-nitrogen cooling, and the study of grain boundaries is described. Author

N63-12208 Atomics International, Canoga Park, Calif.

THE DEVELOPMENT OF LINEAR POWER DETECTION AND RECORDING INSTRUMENT SYSTEMS FOR THE KINETIC EXPERIMENTS ON WATER BOILERS

E. L. Gardner Feb. 1, 1963 50 p 18 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7077) OTS: $1.25

A brief history is presented of the evolution of the linear power recording instrument systems used in the Kinetic Experiments on Water Boilers Program. Reduction of the data taken by these systems showed a systematic dynamic change of calibration during a power transient. Tests were conducted on both the electronic and neutron sensing portions of these systems. It was determined that the ratio of neutron to gamma ray sensitivity changed during a transient. Since the usual chamber compensation methods will not work under such circumstances, a series of shields was constructed and tested to attenuate the gamma ray response of the ionization chambers. Gamma ray attenuators were developed which provided adequate neutron transmission for accurate measurement of power transients with periods as short as one millisecond. Author

N63-12209 Argonne National Lab., Ill.

ARGONNE DUAL NEUTRON DIFFRACTOMETERS USING A SINGLE PRIMARY BEAM

Melvin H. Mueller, LeRoy Heaton, S. S. Sidhu, and John Terandy Nov. 1962 42 p 7 refs

(Contract W-31-109-eng-38)

(ANL-6537)

Dual neutron diffractometers have been designed and built for use at the CP-5 reactor with a number of special features: (1) Two monochromators are used in an in-line arrangement, utilizing the same primary beam with two independent diffractometers, one a horizontal instrument and the other a vertical unit. (2) The two monochromating crystals may be used in transmission or reflection, and each crystal may be accurately positioned by external controls. (3) Considerable variations in the wavelength of the primary beam may be made for both diffractometers by changing the takeoff angle from the monochromator crystals by means of interchangeable pie-shaped segments. (4) The monochromating crystals are located inside of a relatively small, heavily shielded housing which consists of lead, steel, Boral, and depleted uranium walls. (5) The monochromator housing is surrounded with a large moderating shield which consists of stacked 2-in.-thick Masonite die stock forming a 4-ft. cube with a minimum thickness of 2 ft. from the inner housing. (6) The detector arm on the horizontal diffractometer pivots about the center of the diffractometer table or may also be made to pivot about a point approximately 2 ft. from the center of the table. (7) The horizontal table which has optional coupled θ-2 θ motion is constructed so as to support massive accessories, such as cryostat, furnace, and magnet. (8) The vertical unit consists of a Picker diffractometer to which is attached the shielded BF_3 detector and a counterbalance. Various specimen supports may be attached including a single crystal device which permits 360° motion in both chi (χ) and phi (Φ). (9) The movement of the detector arm for both horizontal and vertical instruments may be continuous or incremental. (10) Provision is made to read visually and to move three angles independently for both horizontal and vertical units by means of this stepping motor. The intensity and angle are recorded on x-y recorder and in addition, the intensity versus angle is printed automatically with an IBM typewriter. Author

N63-12279 Aerospace Corp. Laboratories Div., El Segundo, Calif.

A PHOTOMULTIPLIER READ-OUT FOR THE BAUSCH AND LOMB 1.5 METER STIGMATIC SPECTROGRAPH

E. B. Mayfield, G. E. Meloy, and A. Y. Lu Sept. 24, 1962 23 p 12 refs

(Contract AF 04(695)-169)

(TDR-169(3210-06)TR-1; SSD-TDR-62-116)

A photomultiplier read-out for the Bausch and Lomb 1.5 meter stigmatic spectrograph is described. This modification utilizes nine photomultiplier tubes of the side window type, which cover the spectral range between 2000 and 7000 A. Each photomultiplier tube examines a spectral range of approximately 7A, and can cover a range of 1100 A. Details of the mounting, of the fine motion adjustment, and of an inexpensive regulated power supply for the photomultiplier tubes are described. The application of the instrument to determine the apparent gray-body surface temperature indicates that for a 0.001-inch tungsten wire, electrically exploded by a capacitor of 0.5μ charged to an initial voltage of 25,000 volts, the value is 8500 $\pm$275° K. Calibration of the instrument was achieved by the use of a National Bureau of Standards spectrally calibrated tungsten ribbon lamp. Author

N63-12288 Advanced Technology Labs. Div. of American-Standard, Mountain View, Calif.

DESIGN AND DEVELOPMENT OF 3000° F TEMPERATURE-TRANSDUCER SYSTEM Program Progress Report [May 1-31, 1962]

D. L. Rall May 1962 6 p 3 refs

(Contract AF 33(657)-7132)

(ATL-D-811)

Preliminary thermal-response tests of 0.012-inch-thick skin-panel assemblies have been completed. Results for skins with 1-inch-thick Q-felt insulation indicate a transient error of approximately 8.5 to 10.5% as compared with 5% predicted from electrical analog studies. These data are in contrast with results for skins with 0.1-inch insulation, which showed reasonable agreement with predicted performance. Design-verification tests have been initiated. Hot- and cold-vibration tests were completed on six panels (four with 0.012-inch skin and two with 0.030-inch skin). Results indicate that sensor performance is unaffected by the vibration environment. Author

N63-12299 Atomics International, Canoga Park, Calif.

THERMAL PROPERTIES OF REFRACTORY MATERIALS (First Quarterly Progress Report) [August 1 through November 30, 1962]

R. E. Taylor and M. M. Nakata Dec. 1962 22 p 8 refs

(Contract AF 33(657)-7136; ARPA Order 24-62)

(AI-8058)

The status of the development of the transient thermal-property apparatus is presented. Modifications and improvements of the thermal-diffusivity apparatus are described, and data on the diffusivity of titanium carbide from 1350° to 1600° C are given. Changing the area of the temperature measuring holes by a factor of two did not affect the results. The status of thermal-property measurements by existing techniques is also included. Data on the thermal conductivity of titanium nitride from 200° to 1900° C are presented. Author

N63-12300 Bell Helicopter Co., Fort Worth, Tex.

EFFECT OF STIMULUS AMBIGUITY IN THE DISPLAY OF ATTITUDE INFORMATION Technical Report

Claude B. Elam and John H. Emery Sept. 1962 22 p 5 refs

(Contract Nonr-1670(00); ANIP Program)

(Rept. D228-421-013)

Within the Army-Navy Instrumentation Program a great deal of attention has been given to the development of a vertical display based upon the contact analog concept. A problem that must be considered is the position of the vertical display relative to the pilot's line of vision. It has been shown in a previous study that lateral displacement of the vertical display disrupts performance. There are, however, some very practical difficulties involved in placing the display directly in front of the pilot. Of first consideration is the fact that the display might interfere with VFR. It is not the purpose of this report to evaluate the feasibility of a transparent display from an engineering point of view, but rather to determine whether the presence of a grid line display superimposed over the terrain acts to degrade performance. Subjects were required to track in two dimensions (roll and pitch) to a grid alone, to a picture of the real world alone, and to the grid superimposed over the real world picture. No evidence was obtained that the presence of the grid would interfere with VFR. Author

N63-12301 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

STUDY OF A SONIC LOAD RECORDER, VOLUME I Technical Documentary Report [Jan.—Dec. 1961]

Jay H. Ball, Norman Doelling, Denis U. Noiseux, and Edward A. Starke Wright-Patterson AFB, Ohio, Flight Dynamics Lab., Nov. 1962 133 p 15 refs

(Contract AF 33(616)-7789)

(ASD-TDR-62-165; Vol. I)

The feasibility of a compact instrument to measure the accumulated acoustic exposure of a flight vehicle is considered. The output data of the instrument will aid in the estimation of fatigue life. A study of the conditions and parameters involved, together with general requirements of the instrument, is presented. Design criteria and

discussed, such as techniques for amplitude analysis, sampling, and accumulation of data in a directly readable and usable form. A specific design of a breadboard model of the sonic recorder is given with test and performance data under laboratory conditions. A discussion of the effects of temperature, vibration, and power-supply variations is also included. Complete circuit diagrams are provided. Author

N63-12336 Brookhaven National Lab., Upton, N.Y.
EXTENDING THE RANGE OF THE "FRICKE" DOSIMETER UP TO 10^6 RADS
F. J. Haasbroek Apr. 1962 20 p 12 refs
(Sponsored by AEC)
(BNL-763(T-284)) OTS: $0.50

Two alternative methods to extend the upper range of the "Fricke" dosimeter continuously to 10^6 rads are presented. Dosimeter solutions containing higher Fe^{2+} concentrations are irradiated either while bubbled with oxygen or oxygen-free. For the oxygenated system, $G(Fe^{3+})$ values of 16.1 and 15.6 are used for 5 mM and 20 to 50 mM Fe^{2+} solutions, respectively. A $G(Fe^{3+})$ value of 8.0 was determined for the de-aerated system, which appeared to be independent of Fe^{2+} concentration over the range 2 to 50 mM. Both methods are simple and the reproducibility is better than ±2%. Author

16 LIFE SCIENCES

Includes: biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness.

For related information see: 14 Human Behavior; and 28 Space Radiation.

N63-11993 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
AEROMEDICAL ANALYSIS
Charles A. Berry, Howard A. Minners, Ernest P. Mc Cutcheon, and Richard A. Pollard *In its* Results of the Third United States Manned Orbital Space Flight, Oct. 3, 1962 p 23-36 9 refs (See N63-11990 05-32)

Astronaut Walter M. Schirra, Jr., incurred no detectable physiologic decrement during his spaceflight which included over 9 hours of weightlessness. His body functions since the flight have remained normal and unchanged from their healthy preflight condition. A variation of the astronaut's instantaneously observed heart-rate response was noted during flight. Immediately following recovery, an orthostatic rise in heart rate, accompanied by a fall in systolic blood pressure, was observed for a brief period. In-flight ionizing-radiation monitoring showed that the astronaut sustained no significant exposure. Author

N63-12011 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS FROM AZERBAYDZHANSKIY MEDITSINSKIY ZHURNAL [BAKU] (AZERBAYDZHAN MEDICAL JOURNAL) [No. 10] OCTOBER 1962
V. M. Abdullayev and M. S. Isayev Jan. 22, 1963 38 p refs
Transl. of 5 articles from p 16-25, 31-42, and 81-83
(JPRS-17222) OTS: $3.60

CONTENTS:
1. PATHOMORPHOLOGICAL CHANGES IN THE EYE DURING ACUTE RADIATION SICKNESS V. M. Abdullayev p 14-21 5 refs
2. PROTECTIVE EFFECT OF BETA-MERCAPTOETHYLAMINE IN ACUTE RADIATION SICKNESS M. S. Isayev p 22-31 16 refs

N63-12014 Joint Publications Research Service, Washington, D.C.
ARTICLES FROM DOKLADY AKADEMII ANUK (BIOPHYSICS)
V. A. Sondak et al Jan. 22, 1963 16 p 26 refs Transl. of two articles from Doklady Akad. Nauk SSSR (Moscow), no. 4, 1962 p 925-932
(JPRS-17239) OTS: $1.60

CONTENTS:
1. PROTECTIVE EFFECT OF PHYTOLIPOPOLYSACCHARIDES AND VB-2 AGAINST IRRADIATION V. A. Sondak, Ye. P. Gracheva, B. N. Gladyshev, and V. I. Suslikov p 1-6 14 refs
2. ON THE SELECTIVE EFFECT OF ULTRASONIC WAVES ON THE MOLECULAR STRUCTURE OF INSULIN I. Ye. El'piner and L. I. Stekol'nikov p 7-13 12 refs

N63-12015 Joint Publications Research Service, Washington, D. C.
THE SIGNIFICANCE OF THE ADRENAL GLANDS TO THE HEAT RESISTANCE OF AN ORGANISM
F. T. Agarkov (Donets Inst. of Ind. Physiol.) Jan. 23, 1963 12 p 20 refs Transl. of article from Probl. Endokrinol. i Gormonoterap. (Moscow), v. 8, no. 5, 1962 p 15-20
(JPRS-17250) OTS: $1.60

The purpose of this investigation was to elucidate the character of the alteration in the heat resistance of animals subjected to the effects of one of the adrenal hormones, cortisone, a hypophyseal hormone, adrenocorticotropic hormone (ACTH) and adrenalectomy, and to determine the effect of the latter on the development of the state of increased heat resistance which is brought about by dibazol and ascorbic acid. Results indicated: (1) Adrenalectomized rats, simultaneously injected with cortisone, ACTH, ascorbic acid, and dibazol, had a shorter survival time than the control (laparotomized) rats. Adrenalectomy had, therefore, decreased heat resistance; (2) Injections of cortisone in the control group, as well as in adrenalectomized rats, augmented heat resistance, while ACTH did not alter it; (3) Dibazol injections proved ineffective in increasing heat resistance of adrenalectomized rats; (4) Ascorbic acid injections increased the heat resistance of adrenalectomized rats. I.v.L.

N63-12020 Joint Publications Research Service, Washington, D.C.
STUDIES IN HYPOTHERMIA
N. Kh. Abdullayev (Tashkent State Med. Inst.) et al Jan. 23, 1963 15 p Transl. of two articles from the book "Iskusstevennaya Gipotermiya" (Artificial Hypothermy) Tashkent, State Med. Publishing House, Min. of Health Uzbek SSR, 1961 p 3-7 and 21-24
(JPRS-17262) OTS: $1.60

Studies were made of the effects of hypothermia on hemotransfusion and anaphylactic shock and on the morphology and composition of blood of irradiated animals. Hypothermia was found to contribute to shock development and to aggravate hemodynamic disturbances in dogs. Baroreceptor reflexes were sharply depressed; acetylcholine produced a less pronounced depressor reaction, adrenalin and ephedrine gave a hypotensive reaction. Results with sensitized dogs were equivocal; hypothermia prevented the typical anaphylactic blood pressure drop in some dogs but not in others. In rabbits, the combination of hypothermia and irradiation produced a summation of their characteristic blood shifts: the drop in total protein and albumin content and the rise in beta-globulins and alpha-globulins were more pronounced than after irradiation alone. M.P.G.

N63-12023 Atomic Energy Commission. Div. of Technical Information, Washington, D.C.

CONTRIBUTION TO THE STUDY OF THE METABOLISM OF FISSION PRODUCTS. RESEARCH ON THE PHYSICO-CHEMICAL STATE AND THE METABOLIC PATH OF RADIOCERIUM SOLUTIONS

André Aeberhardt Oct. 1962 126 p 64 refs Transl. by JPRS of "Contribution à l'étude de métabolisme des produits de fission. Recherches sur l'état Physico-Chimique et le devenir métabolique des solutions de radiocerium" Commissariat à l'Energie Atomique, Saclay (France), 1961

(AEC-TR-5242; CEA-1856) OTS: $1.50

A new method is used to investigate the physicochemical state of cerium as a function of the pH of extremely dilute solutions of cerium nitrate and chloride (Ce^{144}_{58} - Pr^{144}_{59}, carrier-free). A study of sedimentation curves permitted the evaluation of the relative sizes of the colloidal aggregates as a function of the pH of the solution. Knowledge of the ionic or colloidal nature of the cerium in solutions permitted the determination of the blood transport mechanism of carrier-free cerium by experiments carried out in vitro on plasma and on blood of different test animals and subsequently in vivo with rats and rabbits. Results indicated that ionic cerium does not become colloidal in contact with blood. Important differences were found not only as to the nature of the organ where fixation takes place, but also in the relative amount of fixation in the liver, the spleen, and the skeleton. Moreover, the relative extent of fixation varied according to the dimensions of the particle aggregates, the latter being dependent upon the pH of the solutions used. The importance of the physicochemical factors in the distribution and the metabolism of cerium in animal organisms is indicated by these results. I.v.L.

N63-12065 Joint Publications Research Service, Washington, D.C.

TRANSLATIONS FROM GIGIYENA I SANITARIYA [MOSCOW] (HYGIENE AND SANITATION) [V. 27] NO. 9, 1962

Jan. 23, 1963 26 p 29 refs Transl. of 2 articles from p 30-34 and 85-90

(JPRS-17249) OTS: $4.60

CONTENTS:

1. SOME FACTS ON NATURAL ENVIRONMENTAL RADIOACTIVITY CAUSED BY THE PRESENCE OF K-40 V. I. Ryadov and N. V. Petrukhin p 1-10 4 refs (See N63-12066 05-16)
2. RECORDING OF PHYSIOLOGICAL FUNCTIONS IN MAN WHILE PERFORMING PHYSICAL WORK R. L. Rabinovich p 11-23 25 refs (See N63-12067 05-16)

N63-12066 Joint Publications Research Service, Washington, D.C.

SOME FACTS ON NATURAL ENVIRONMENTAL RADIOACTIVITY CAUSED BY THE PRESENCE OF K-40

V. I. Ryadov and N. V. Petrukhin Transl. from Gigiyena i Sanit. (Moscow), v. 27, no. 9, 1962 p 30-34 *In its* Translations from Gigiyena i Sanitariya Jan. 23, 1963 p 1-10 4 refs (See N63-12065 05-16) OTS: $4.60

The abundance of potassium-40 in soil, plant, and animal samples collected in an area with low background radioactivity was determined. The values obtained are considered to be an indicator of the natural environmental radiation, and may be used as a baseline in determining the radioactivity due to artificial fission products in other areas. M.P.G.

N63-12067 Joint Publications Research Service, Washington, D.C.

RECORDING OF PHYSIOLOGICAL FUNCTIONS IN MAN WHILE PERFORMING PHYSICAL WORK

R. L. Rabinovich Transl. from Gigiyena i Sanit. (Moscow), v. 27, no. 9, 1962 p 85-90 *In its* Translations from Gigiyena i Sanitariya Jan. 23, 1963 p 11-23 25 refs (See N63-12065 05-16) OTS: $4.60

A review of instruments for recording the physiological responses of man while actually performing physical work is presented. These instruments fall into two main groups: those that use a pickup on the body connected to the recorder with wires, and those that depend on radio transmission of the electrical impulses generated by the body. Both types hold great promise for research on both adults and children. M.P.G.

N63-12133 Joint Publications Research Service, Washington, D.C

THERMAL AND ELECTRIC BURNS

A. A. Vishnevskiy and M. I. Shrayber Jan. 24, 1962 32 p Transl. of Chap. 7 from book "Voyenno-Polevaya Khirurgiya" Moscow, 1962 (JPRS-17274) OTS: $3.60

A comprehensive study is made of burns due to thermal causes, radiation, nuclear and atomic explosions, and a similar review is presented of frostbite and electric burns. In all cases, associated phenomena are enumerated and described, and suitable treatment for the various types of burns and frostbite are described. A.S.

N63-12190 Joint Publications Research Service, Washington, D. C.

LIFE IN A METEORITE

Docent F. Zigel Jan. 28, 1963 9 p Transl. from Ogonek, no. 47, Nov. 1962 p 28-29

(JPRS-17326) OTS: $0.50

An internal portion of the Sikhote-Alinskiy meteorite which fell to earth on Feb. 12, 1947, was processed to determine whether it contained extraterrestrial life. Methods which insured full sterility were employed. The mass under study was pulverized and placed in a culture medium. The second day, a film was noticed on the culture broth, which demonstrated, when a sample was examined, that it contained mobile organisms. The organisms resembled ozokerite rods, found in ozokerite, a rare mineral which is obtained from the Cheleken Island near the eastern shore of the Caspian Sea. The organisms grown in culture from the meteoritic sample were called thermophilic meteoritic rods because they resemble the ozokerite rods and can withstand a temperature of 180° F for an hour or longer. The meteoritic rods secrete a fat-like opaque white substance. Microcolonies of these meteoritic rods form generative threads easily seen under the microscope. These threads are considered visible proof of the presence of living organisms within the meteorite. It is believed that the meteorite is a fragment from the planet Phaeton, in the asteroid belt, because this planet had an atmosphere and the water which is needed to support this form of living organism. A.S.

N63-12213 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

EFFECT OF ULTRA-HIGH VACUUM ON *BACILLUS SUBTILIS* VAR. NIGER

Frank A. Morelli, Francis P. Fehlner, and Charles H. Stembridge Oct. 1962 6 p 5 refs Repr. from Nature v. 196, no. 4850, Oct. 13, 1962 p 106-107

(NASA Contract NAS7-100)

(JPL-TR-32-289)

Microorganisms were exposed to ultrahigh vacuum to determine their viability under space conditions. Spores of *Bacillus subtilis* var. *niger* were exposed to 10^{-9} mm. Hg. vacuum for 35 days. After exposure, the samples were cultured and the count compared to the original count. The tests showed that the organism could survive exposure to ultrahigh vacuum. R.C.M.

N63-12235 Cedars of Lebanon Hospital. Inst. for Medical Research, Los Angeles, Calif.

THE COMMON ORIGIN OF PRECORDIAL VIBRATIONS

Clarence M. Agress, Stanley Wegner, Daniel J. Bleifer, Alfred Lindsey, John Van Houten, Kenneth Schroyer, and Harley M. Estrin [1962] 16 p 33 refs

(NASA Grant NsG-289-62)

OTS: $1.60 ph, $0.80 mf

Experiments were performed on dogs in which the left ventricular pressure curves were obtained simultaneously with precordial vibration tracings. An analog computer was utilized to derive a tracing resembling the vibrocardiogram from the pressure curve. A Krohn-Hite filter was used to obtain an apexcardiogram, a phonocardiogram, and an accelerogram from the vibrocardiogram. It was demonstrated that a record closely resembling the left ventricular pressure tracing can be obtained by integration of the vibrocardiogram. The basic relationship of the precordial vibratory tracings to the contraction and relaxation of the left ventricle was demonstrated. This contractile energy is modified through the transfer media of the lung-thorax which simulates a differentiating system. The waveform of the transferred energy is a function of the response characteristics of the technique applied. I.v.L.

N63-12236 Cedars of Lebanon Hospital. Inst. for Medical Research, Los Angeles, Calif.

MEASUREMENT OF PRE-EJECTION AND EJECTION-CONTRACTION TIME BY THE VIBROCARDIOGRAM

Clarence M. Agress, Stanley Wegner, and Daniel J. Bleifer [1962] 22 p 25 refs
(NASA Grant NsG-289-62)
OTS: $2.60 ph, $0.86 mf

The relationship between the major wave intervals and the events of the cardiac cycle was investigated using vibrocardiograms. The major waves produced by precordial movement in dogs, as recorded by the capacitance microphone placed near the left sternal border, were identified. Correlation of these waves with left ventricular hemodynamic response has been determined and affords an accurate measurement, in the closed-chest subject, of isometric contraction and ejection. These relationships were determined to an accuracy of 0.002 second and were not altered after exercise. The catheter measurements in resting animals were: average pre-ejection time, 0.056 second with a 0.036- to 0.083-second range; average ejection-contraction time, 0.163 second with 0.116- to 0.228-second range. Vibrocardiograms measuring the same intervals precordially produced the following correlation: average pre-ejection contraction time, 0.055 second with a 0.032- to 0.075-second range. The ejection-contraction time averaged 0.158 second with a 0.114- to 0.220-second range. The same close correlation exists in post-exercise measurements. I.v.L.

N63-12238 Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

THE EFFECTS OF SHOCK TUBE GENERATED, STEP-RISING OVERPRESSURES ON GUINEA PIGS LOCATED IN SHALLOW CHAMBERS ORIENTED SIDE-ON AND END-ON TO THE INCIDENT SHOCK Technical Progress Report

V. R. Clare, D. R. Richmond, V. C. Goldizen, C. C. Fischer, D. E. Pratt, C. S. Gaylord, and C. S. White Washington, Defense Atomic Support Agency, May 31, 1962 44 p 21 refs
(Contract DA-49-146-XZ-055)
(DASA-1312)

A total of 308 guinea pigs was exposed to air blast in 4 close-fitting, shallow, rectangular chambers mounted on the top, bottom, and sides of an air-driven shock tube. With a reflecting plate at the downstream edge of the chambers, the animals were exposed to long-duration shock overpressures that initially rose in a single step. The LD_{50} -24-hr. reflected pressure calculated from grouping all positions was 36.2 ± 0.8 psi. By moving the reflecting plate to various distances downstream of the chambers, shock overpressures that initially rose in two steps were applied. The results were that the animals' tolerances to overpressure rose as the time between pressure steps was increased. Comparison of the LD_{50}'s obtained with animals in each chamber revealed that there was not a significant statistical difference in their tolerances, whether they were "loaded" initially with the single-step pulse from their right, left, dorsal, or ventral surfaces. Animals that survived pressure-time conditions in the lethal range were considered as having been injured by the blast, and were all pooled for 30-day serial sacrifice. It was found that the lung hemorrhage "cleaned up," and the lung weights returned to normal in 7 to 10 days as did the submucosal hemorrhages in the stomach and intestines. The body-weight curve displayed an initial drop in 2 to 3 days, after which it rose to the starting level by the sixth day and then paralleled the controls. Author

N63-12239 Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

A TENTATIVE ESTIMATION OF MAN'S TOLERANCE TO OVERPRESSURES FROM AIR BLAST Technical Progress Report

Donald R. Richmond and Clayton S. White Washington, Defense Atomic Support Agency, Nov. 7, 1962 39 p 34 refs
(Contract DA-49-146-XZ-055)
(DASA-1335)

Tentative estimates of the sharp-rising overpressures as a function of duration, which represent a lethal hazard to the 70-kg. animal 1, 50, and 99 percent of the time, were presented. The predictions were based on interspecies correlations and extrapolations encompassing blast-tolerance data for six mammalian species. The tentative application of the data to indicate human blast tolerance was discussed, and relevant uncertainties in the estimates were emphasized. It was also pointed out that biologic tolerance would be different for airblast pulses having nonideal waveforms frequently associated with various geometries of exposure. Selected pathophysiological information pertinent to the biological response following blast exposure was given; namely, survival time and selected postshot observations of dogs and goats. Author

N63-12240 Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

THE EXPOSURE OF GUINEA PIGS TO PRESSURE-PULSES GENERATED DURING THE END-TO-END TEST (NO. 2) OF ATLAS MISSILE 8-D (MARCH 31, 1962) Technical Progress Report

D. R. Richmond June 26, 1962 18 p 5 refs
(Contract DA-49-146-XZ-055)
(DASA-1313)

To help determine the extent of the blast hazard to the operator of a Pressure Control Unit, an Atlas 8-D missile was pressurized to 35 psi with gaseous nitrogen and ruptured with an explosive charge. Three guinea pigs were placed on the Pressure Control Unit which was located beneath the ramp 90 ft from the missile. In addition, ten guinea pigs were placed on the surface of the simulated ramp at 30-, 35-, 75- and 94-ft ranges. Following the burst, missile fragments littered the test area, although none were found at the Pressure Control Unit. Overpressures of only 0.3 psi were recorded in the vicinity of the Pressure Control Unit. The pressure pulse was slow rising (9 to 14 msec) and endured for about 25 msec. The three guinea pigs at that location were unharmed. At the 30-ft ranges, pressures of 1.1 to 1.4 psi were recorded with times to peak and duration of 2 to 3 msec and 13 to 16 msec, respectively. One guinea pig's eardrum was ruptured, and one animal sustained a slight degree of lung hemorrhage. The other eight animals were unhurt. The biological results were discussed in relation to the pressure-time data. Author

N63-12249 Federal Aviation Agency. Civil Aeromedical Research Inst., Oklahoma City, Okla.

A CASE OF SURVIVAL OF EXTREME VERTICAL IMPACT IN SEATED POSITION

Richard G. Snyder Oct. 1962 17 p 8 refs
(CARI-62-19)

Physical, biophysical, and medical data are presented concerning the case of a 20-year-old male of excellent physical condition who jumped from the Golden Gate Bridge in San Francisco, surviving for ten days a free-fall deceleration in the seated position (buttocks to head) of a calculated 4128 g. for .0023 seconds. Specific trauma

resulting from this impact indicates that this may closely approach the extreme human survival tolerance to impact in this position, and that while distribution of forces through support of the upper torso may greatly minimize injury to the skeletal system, protection of internal organs will present a much more difficult problem. Author

N63-12250 Federal Aviation Agency. Civil Aeromedical Research Inst., Oklahoma City, Okla.

CIVIL AEROMEDICAL RESEARCH: RESPONSIBILITIES, AIMS, AND ACCOMPLISHMENTS

Stanley R. Mohler Oct. 1962 21 p 64 refs
(CARI-62-20)

Civil aeromedical research, conducted by the Aviation Medical Service of the Federal Aviation Agency, is concerned primarily with (1) elucidating those mental and physical attributes of civil airmen most vital to the safe operation of present and proposed civil aircraft; (2) providing the civil aviation industry, from the designer to the operator, with adequate information relative to the physiological, psychological and medical characteristics of civil aircrew members, passengers, and ground support personnel; (3) determining the means by which human tissues may be protected from injury during civil aircraft accidents; and (4) developing means by which the effects of aging, drugs, fatigue, hypoxia, toxic substances and other factors can be measured with respect to their influence on performance by civil airmen. Author

N63-12251 Chicago U. USAF Radiation Lab., Ill.

Quarterly Progress Report No. 46 [RADIATION EFFECTS ON ANIMAL TISSUES]

Kenneth P. DuBois et al Jan. 15, 1963 162 p 139 refs
(Contract AF 41(609)-1693)

CONTENTS:

THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES

1. THE INFLUENCE OF X-IRRADIATION ON THE REDUCTASE ACTIVITY OF THE LIVERS OF RATS Kenneth P. DuBois and Bernard E. Hietbrink p 1-14 11 refs
2. INFLUENCE OF X-IRRADIATION AND A NITROGEN MUSTARD ON THE DEVELOPMENT OF A THIOPHOSPHATE-OXIDIZING ENZYME SYSTEM IN THE LIVERS OF YOUNG MALE RATS Bernard E. Hietbrink, Marjorie Keshmiri and Kenneth P. DuBois p 15-25 13 refs
3. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION-INDUCED CHANGES IN ENZYME ACTIVITIES IN CERTAIN RAT TISSUES Bernard E. Hietbrink and Marjorie Keshmiri p 26-34 13 refs

THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA OR FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS

1. MODIFICATION AND DOSIMETRY OF THE PLUTONIUM-BERYLLIUM NEUTRON IRRADIATION FACILITY J. Doull, A. Sandberg and D. G. Oldfield p 35-44 2 refs
2. EFFECT OF DOSE RATE ON LIFE SPAN SHORTENING OF MICE EXPOSED TO CHRONIC LOW LEVEL FAST NEUTRON IRRADIATION A. Sandberg and J. Doull p 45-53 13 refs
3. STUDIES ON THE TOXICITY OF RARE EARTH COMPOUNDS AND THEIR INFLUENCE ON RADIATION LETHALITY David W. Bruce and Kenneth P. DuBois p 54-62 14 refs
4. HISTOLOGICAL FINDINGS IN THE BLOOD VESSELS OF RATS AND MICE EXPOSED TO ACUTE AND CHRONIC X-IRRADIATION WHILE FED VARIOUS SYNTHETIC HIGH FAT DIETS D. Vesselinovitch, R. W. Wissler, J. Meskauskas, and J. Doull p 63-93 45 refs

PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS

1. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE V. Plzak, M. Root, and J. Doull p 94-115 2 refs
2. FURTHER STUDIES ON THE MECHANISM OF RADIOPROTECTION AFFORDED BY CYANIDE AND VARIOUS NITRILES J. Dilley and J. Doull p 116-133 10 refs
3. RADIOPROTECTIVE EFFECTS IN PROTON-IRRADIATED MICE PRETREATED WITH CHEMICAL PROTECTORS D. G. Oldfield, J. Doull, V. Plzak, A. Hasegawa and A. Sandberg p 134-158 18 refs

N63-12277 Federal Aviation Agency. Civil Aeromedical Research Inst., Oklahoma City, Okla.

EFFECT OF INCREASED VENOUS PRESSURE ON RENAL HEMODYNAMICS

Lerner B. Hinshaw, Charles M. Brake, P. F. Iampietro, and Thomas E. Emerson, Jr. Oct. 1962 14 p 14 refs
(CARI-62-18)

Conflicting evidence exists in regard to the effects of increased venous pressure on renal hemodynamics. Experiments to clarify its role were carried out on 28 intact innervated or isolated perfused dog kidneys. Findings indicate the absence of a "venous-arteriolar" reflex. Decreases in total resistance occur as venous pressure is increased through a wide range in both innervated and isolated perfused kidneys. Intrarenal venous and tissue pressures and blood flow are unaffected by large increases in venous pressure (21 to 75 mm Hg), although venous segment resistance declines markedly. Decreases in blood flow are seen when renal vein pressure approaches or exceeds intrarenal venous and tissue pressures. Results confirm previous investigations regarding the importance of tissue pressure and intrarenal venous pressure in renal hemodynamics, which appear to "buffer" the kidney against effects of elevated venous pressure through a variable but unusually large venous pressure range. The phenomenon of autoregulation may be extended to include a tendency for renal blood flow constancy in the face of wide swings in both renal artery and venous pressures. Author

N63-12281 Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

THE TOLERANCE OF GUINEA PIGS TO AIR BLAST WHEN MOUNTED IN SHALLOW, DEEP, AND DEEP-WITH-OFFSET CHAMBERS ON A SHOCK TUBE Technical Progress Report

Donald R. Richmond, Victor R. Clare, and Clayton S. White Oct. 27, 1962 27 p 25 refs
(Contract DA-49-146-XZ-055)
(DASA-1334)

One hundred and eighteen guinea pigs were exposed to air blast in shallow, deep, and deep-with-offset chambers mounted on a shock tube. The LD_{50} for 24 hours, in terms of the incident shock pressures measured adjacent to the chambers, was calculated by probit analysis to be 34.9 psi, 19.5 psi, and 26.8 psi for animals in the shallow, deep, and deep-with-offset chambers, respectively. According to the LD_{50} incident pressures, the shallow chambers offered the most protection against air blast; the deep chambers offered the least. Comparing the LD_{50}-pressure "dose" at the animals' location revealed little difference in their tolerance to overpressure, per se; i.e., LD_{50} reflected pressures measured by gauges within the deep and deep-with-offset chambers were 34.6 psi and 35.9 psi, respectively. The LD_{50} incident shock pressure of 34.9 psi in the shallow chambers was considered to be the "dose" at the animal's location in that instance. The protection against blast provided by the three chambers, and the response of animals to the particular pressure-time patterns encountered, are discussed. Author

N63-12321 Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

A CASCADE IMPACTOR OPERATING AT LOW VOLUMETRIC FLOW RATES Technical Progress Report

T. T. Mercer, M. I. Tillery, and C. W. Ballew Dec. 1962 26 p 13 refs
(Contract AT(29-2)-1013)
(LF-5) OTS: $0.50

A five-stage cascade impactor, designed to operate at 50 to 150 cm^3/min, is described. The device comprises four impactor stages, in which round jets are used, and a filter stage. The method of calibration of the instrument is described, and it is shown that the curves of impaction efficiency as a function of the $\sqrt{\psi}$ are similar to those of large impactors of similar design, with $\sqrt{\psi} = 0.29$ for a collection efficiency = 0.5. For deposit thicknesses of 0.05 to 55.7 mg/cm^2, the wall losses vary between 1.4 and 9.8 percent. The significance of the collection efficiency and wall losses, with respect to sampling for mass distributions, is discussed. Author

N63-12329 Albany Medical Coll., N.Y.
BICARBONATE EXCRETION DURING HYPOTHERMIA
G. S. Kanter Brooks AFB, Tex., School of Aerospace Medicine, Nov. 1962 9 p 18 refs
(Contract AF 41(657)-393)
(SAM-TDR-62-123)

The investigation was designed to determine whether the renal loss of bicarbonate contributes significantly to the acidosis of hypothermia. Excretion of bicarbonate during hypothermia was studied in 5 infused (6% creatinine in saline at 0.4 ml./min.) and 5 noninfused dogs. Animals were anesthetized; artificial respiration was not used. In the noninfused group, bicarbonate excretion did not increase significantly during hypothermia. Urinary pH remained at control levels of about 6.2. The fall in arterial pH is therefore not due to uninary bicarbonate loss. Conversely, the urinary pH in the infused group increased to 6.7 because of increased excretion of bicarbonate. Increased excretion in this group was statistically significant at the 27° C level. Urine pH in the 3 animals with the highest urine flow in the latter group did approach plasma levels of pH 7.0. In spite of the increased renal loss of bicarbonate in the infused group, insufficient bicarbonate was excreted to account for the decrease in arterial pH. Considering the fall in arterial pH, it is striking that the hypothermic kidney in both groups was not able to acidify the urine. Author

N63-12330 Albany Medical Coll., N.Y.
RENAL REGULATION OF BICARBONATE LOADS DURING HYPOTHERMIA
G. S. Kanter Brooks AFB, Tex., School of Aerospace Medicine, Dec. 1962 11 p 21 refs
(Contract AF 41(657)-393)
(SAM-TDR-62-133)

The ability of the hypothermic kidney to handle massive exogenous bicarbonate loads was studied in 5 dogs given 2.6% $NaHCO_3$ plus 0.75% creatinine and 0.1% PAH intravenously at the rate of 4.0 ml./min. The renal hemodynamic pattern was typical of hypothermia with decreasing GFR, RPF, and blood pressure, along with increasing renal resistance. Urine pH rose to 7.95 while arterial pH, corrected to body temperature, reached a maximum of 7.56 and then slowly declined to 7.51 at 27° C. The acidosis of hypothermia is difficult to counteract. In spite of the fall in GFR, the urine flow, under the influence of the hyperosmotic load, increased progressively throughout the exposure. A depressing effect of cold on tubular transport of bicarbonate was seen. Although the bicarbonate load presented to the tubules remained near control levels, the reabsorption of bicarbonate fell from a normothermia value of 1.5m Eq./min. to 0.9m Eq./min. at 27° C. Author

17 MACHINE ELEMENTS AND PROCESSES

Includes: bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; and materials fabrication, handling, and inspection.

For related information see: 06 Auxiliary Systems.

N63-11974 Hanford Atomic Products Operation, Richland, Wash.
POSTIRRADIATION EVALUATION OF ZIRCALOY-2 PRTR PRESSURE TUBES, PART I
L. J. Defferding Nov. 1962 37 p 4 refs
(Contract AT(45-1)-1350)
(HW-73698, rev.) OTS: $1.00

The Plutonium Recycle Test Reactor (PRTR) is a heavy-water cooled and moderated, vertical pressure-tube reactor. The primary coolant flows upward through 85 Zircaloy-2 pressure tubes at an average of 107 gpm. The nominal inlet conditions are 478° F and 1090 psig, and the nominal outlet conditions are 530° F and about 1080 psig. The connections between the Zircaloy pressure tubes and the stainless steel out-of-reactor piping are bolted flange-type connections with spiral-wound, asbestos-filled gaskets. This reactor represents one of the first major elevated temperature applications of Zircaloy-2 as a pressure-containing structural material. Since prior experience with Zircaloy-2 in comparable operating environments consists only of a few years' experience with single-tube test loops, a pressure-tube surveillance program has been undertaken in conjunction with the PRTR operation. This surveillance program consists of in-reactor monitoring, preirradiation testing, and the periodic removal of selected tubes for postirradiation destructive examination. To date, three tubes have been removed after 2, 6, and 10 weeks of actual reactor operation. This report presents the observations made on these tubes, and an analysis of exposure to the reactor environment as it affects the properties of Zircaloy-2 pressure tubes. Author

N63-11977 California Inst. of Tech. Div. of Engineering and Applied Science, Pasadena
THE PULSATION METHOD FOR GENERATING CAVITATION DAMAGE
Milton S. Plesset Dec. 1962 24 p 4 refs
(Contract Nonr-220(28))
(Rept. 85-22)

Results are presented for the cavitation damage of materials by a laboratory procedure in which the cavitation is applied in an intermittent or pulsed, manner. It is found that the rate of damage in materials sensitive to corrosion is much greater for pulsed cavitation than for steady cavitation when the cavitating liquid is salt water. The damage rate is also increased by the pulsed cavitation for these materials when the cavitating liquid is distilled water, but by a smaller amount than in the salt solution. For corrosion-insensitive materials, there is no significant difference between the cavitation damage rate when it is applied in a steady or in a pulsed manner. Author

N63-12017 Joint Publications Research Service, Washington, D. C.
INVESTIGATING THE PERFORMANCE OF CORRODED UNITS OF HYDRAULIC AND PNEUMATIC SYSTEMS
A. A. Mikhaylov and A. I. Lipin Jan. 23, 1963 20 p Transl. of article from Vestn. Mashinostr. (Moscow), no. 7, July 1962 p 38-41
(JPRS-17253) OTS: $1.60

Tests were conducted to determine the degree of corrosion on the surfaces of items such as cylinders, taps, and switches; methods

were developed for restoring the corroded parts. The degree of corrosion was evaluated by measuring the depth of the pittings and by counting their number on a section of the surface. The average corrosive depths were in the range of 0.2 to 0.4 mm; maximum corrosive depth was 0.8 to 0.9 mm. The greater the number of pits on a portion of the surface area, the less their depths, and vice versa. It is determined that corrosion can best be removed by a solution consisting of hydrochloric acid (250 to 280 g/liter) and inhibiter PB-5 (8 to 10 g/liter). The acid residue is neutralized by a solution of potassium sodium biochromate (50 to 80 g/liter). To restore the machinery parts, following the removal of the corrosion, and to ensure a high resistance to corrosion, chroming in layer thickness up to 0.2 mm is carried out. D.B.

N63-12045 Massachusetts Inst. of Tech. Electronic Systems Lab., Cambridge

ELECTRON GUN FOR EVAPORATION OF OXIDE FILM

Paul J. Tallerico June 1962 39 p 11 refs

(NASA Grant NsG-234-61; Contracts AF-33(657)-7644 and AF-33 (616)-7700)

(ESL-TM-141) OTS: $3.60 ph; $1.37 mf

The design and development of two types of electron beam sources for evaporation of refractory oxides is described. The first gun, having a hemispherical shape, was expected to have geometrical advantages making it useful for vacuum evaporation applications. However, the electrode configuration required to achieve high current efficiency proved to be an impractical structure. A Pierce gun was developed which is capable of providing a power density of 3 kilowatts per square centimeter in a spot size of several square millimeters. This concentration of power is adequate to evaporate alumina. A theoretical study presented describes the maximization of power density in a Pierce gun where the optimum geometry is determined by both thermal velocity and space charge effects. Author

N63-12105 Alloyd Electronics Corp., Cambridge, Mass.

A STUDY OF ELECTRON-BEAM WELDING Third Quarterly Report

S. S. White Watertown Arsenal Labs., May 1962 99 p 10 refs

(Contract DA-19-020-ORD-5484)

(WAL-401.54/2-4)

Techniques previously developed for the utilization of the electron beam as a practical tool for post heating of titanium alloys have been applied to the Ti-2½ A1-16V alloy. With slight modifications, these techniques have been found applicable to H-11 hot work die steel, and types A-286 and 301 stainless steels. Electron-beam post-heat generally caused increased strains and impact resistances without strength losses. It was established that strength increases are most feasible when electron-beam post-heating is applied to materials work hardened prior to welding. Correlations between steel gaseous content and impact resistance are also discussed. Author

N63-12113 Budd Co. Materials Research Lab., Philadelphia, Pa.

DEVELOPMENT OF AUTOMATIC QUALITY CONTROL FOR RESISTANCE WELDS IN ALUMINUM ALLOYS. PHASE I. A STUDY OF THE CHANGE IN WELD ZONE RESISTANCE IN SPOT WELDING ALUMINUM ALLOYS

Richard P. Hurlebaus Feb. 20, 1962 209 p 21 refs

(Contract DA-36-034-ORD-3217-RD)

The study of resistance spot welding of several commercial aluminum alloys using three phase power supply has shown a correlation between the weld zone resistances and the weld nugget development. A three phase frequency converter spot welding machine with pulse counting timing was used for this study. Spot weld tests on a 0.020-in., 0.025-in., and 0.050-in. gage and alloys 2024, 2014, 7075, 5052, 5086, and 5456 alloys with recognized welding schedules were made to study the resistance-time characteristics of each material. Weld tests showed the weld nugget was formed after one or two pulses of weld current. This was a desirable reference point. Also, the weld zone resistance-time graphs showed the resistances decreased continuously during weld time. The correlation of weld zone resistance changes with weld size or strength were less predictable in the 0.020-in. gage than in the 0.050 in. gage. The 5086 and 5456 alloys were more predictable in the resistance change vs. weld size than were the heat treatable alloys 2024, 2014, and 7075. Resistance spot welding of dissimilar alloys and gages indicated the weld zone resistances were more characteristic of the resistance-time graphs for the thinner material. Author

N63-12156 Republic Aviation Corp., Farmingdale, N. Y.

HIGH TEMPERATURE FASTENERS Fifth Quarterly Report, July 1, 1962 thru Nov. 16, 1962

C. J. Shaver and J. H. Wagner Dec. 12, 1962 88 p 6 refs

(Contract AF 33(616)-8104)

(ESRD-7-19; RAC-1045)

Material production for Phase II (development) is not yet complete. The D-35 columbium alloy production resulted in less than 50% of the required alloy becoming available at the half-inch-diameter size. This material is currently undergoing reduction to the required fastener size rounds. Testing has begun and includes: tension tests over the temperature range – 100° F to 2750° F; double shear tests over the temperature range – 320° F to 2500° F and some fatigue testing at room temperature and 2000° F. Author

N63-12165 Texas U. Defense Research Lab., Austin

EXPERIMENTAL INVESTIGATION OF THE IMPACT PROBE METHOD FOR DETERMINING LOCAL SKIN FRICTION IN THE PRESENCE OF AN ADVERSE PRESSURE GRADIENT FOR A RANGE OF MACH NUMBERS FROM 1.70 TO 2.75

Oliver Hill (M. S. Thesis) Jan. 1963 112 p 20 refs

(Contract NOrd-16498)

(DRL-498; CF-3010)

This thesis presents the results of an experimental program to determine the feasibility of using a surface impact probe to measure values of local skin friction in a turbulent boundary layer over a range of Mach numbers and pressure gradients. This work is an extension of previous work on adverse pressure gradients which was done at a nominal Mach number of 2.0. The present investigation was conducted on an adiabatic flat surface which formed the test-section floor of a variable Mach number supersonic wind tunnel. The Mach numbers ranged from 1.70 to 2.75 with adverse pressure gradients of zero to 1.57 psi/in. Author

N63-12168 Sperry Gyroscope Co., Great Neck, N. Y.

ROCKET ENGINE ANALYZER AND DECISION INSTRUMENTATION (READI) INVESTIGATION. VOLUME I—SUMMARY Final Report, Phase I

E. S. Joline et al Dec. 1962 81 p For Vol. II see N63-12169 05-17

(NASA Contract NAS8-4003)

(CA 4251-0160, Vol. I) OTS: $8.10 ph, $2.63 mf

The rocket-engine analyzer and decision-instrumentation concept comprises an on-board electronic system that analyzes the condition of a rocket propulsion system and takes corrective action, either automatically or through the pilot, in order to increase the probability of mission success and safety of the crew. This concept has been investigated to: determine its economic feasibility, develop a design approach, and gain familiarization with the functional operation and equipment required for a typical system. A philosophy of approach and detailed design and evaluation procedure are described in which the input data and assumptions are clearly identified, and the calculations are performed by a digital computer. An equipment configuration is described, and special reliability techniques are discussed which will permit achieving the functional and reliability requirements as determined by the design procedure.

These design and equipment approaches have been applied to a representative mission-vehicle-engine combination. The results indicate that application of the READI concept to launch vehicles offers a substantial potential return in reduction of mission risk. Author

N63-12169 Sperry Gyroscope Co., Great Neck, N. Y.
ROCKET ENGINE ANALYZER AND DECISION INSTRUMENTATION (READI) INVESTIGATION. VOLUME II—APPENDICES
Final Report, Phase I
E. S. Joline et al Dec. 1962 226 p For Vol. I and abstract see N63-12168 05-17
(NASA Contract NAS8-4003)
(CA-4251-0160, Vol. II) OTS: $15.00 ph, $6.98 mf

N63-12189 Joint Publications Research Service, Washington, D.C.
TRANSISTORIZED CONTROL SYSTEMS FOR AN INFORMATION STORAGE DEVICE USING PIEZOELECTRIC SUBSTANCES
Ye. I. Mamonov and Yu. M. Koval'skiy Jan. 28, 1963 18 p Transl. from Vychislitel'naya Tekhnika (Moskovskiy Inzhenerno-Fizicheskiy Institut) (Computing Technique, Moscow Engineering-Physics Institute) no. 3, Moscow, 1962 p 112-122
(JPRS-17323) OTS: $0.50

An electronic control system has been constructed for testing piezoelectric matrices as information storage elements. The control system contains circuits for write, read, and sensing information, and amplifier circuits. The write and write-read amplifiers perform the functions of logic circuits. Preliminary tests with this control system confirm the practical possibility of using piezoelectric-element matrices as information storage devices. R.C.M.

N63-12197 Joint Publications Research Service, Washington, D.C.
THE INFLUENCE OF HEAT TREATMENT BY A CURRENT OF HIGH FREQUENCY ON THE CORROSION OF WELDED JOINTS OF Kh 18n9T STEEL
V. A. Suprunov and V. N. Kisel'nikov Jan. 29, 1963 10 p 8 refs Transl. from Izvest. Vyssh. Ucheb. Zaved, Khim. i Khim. Tekhnol., (Moscow), v. 5, no. 2, 1962 p 336-339
(JPRS-17356) OTS: $0.50

The hardening of welded joints of a chromium-nickel austenite steel by induction heating with high-frequency current was investigated. Results indicated: (1) a pronounced increase in the corrosion resistance of the joints; and (2) an elimination of intercrystallite corrosion as well as an equalization of structure hardness within the zones adjacent to the welded seam. This method of enhancing corrosion resistance can be employed at chemical machinery-building plants where welding is used to manufacture items made of chromium austenite steels. I.v.L.

N63-12255 Allegany Ballistics Lab., Hercules Powder Co., Cumberland, Md.
MINIMIZING INITIATION HAZARDS THROUGH PROPER SELECTION OF MATERIALS OF FABRICATION
R. L. Keefe, E. A. Platt, and R. H. Richardson July 1962 25 p 3 refs Presented at the 4th Annual Explosive Safety Seminar on High Energy Solid Propellants, Langley Field, Va., Aug. 7-9, 1962
(Contract NOrd-16640)
(ABL/Z-48)

The information obtained from the investigations conducted indicates that there are many factors to be considered in selecting the proper materials of fabrication for solid propellant processing facilities. Selecting the proper materials of fabrication can reduce the impact and friction hazards significantly. The impact and friction tests, although limited in some aspects, are excellent tools for dividing materials into general classes of usefulness. Although studies of the factors influencing impact and friction results are not complete, it is apparent that the modulus of compression, hardness, and coefficient of friction are some of the major factors to be considered. In the application of these materials, consideration must be given not only to the impact and friction results and such factors as modulus of compression and coefficient of friction, but also thermal and electrical conductivity, structural strength, load bearing characteristics and dimensional stability. In addition, complete analysis with testing under simulated conditions is required to ensure that the expected improvement is realized and does not create an unforeseen hazard. Author

N63-12337 Brookhaven National Lab., Upton, N. Y.
AN AUTOMATIC LIQUID-NITROGEN TRANSFER SYSTEM
George J. Hummer Jan. 1962 9 p
(Sponsored by AEC)
(BNL-764(T-285)) OTS: $0.50

This note describes an automatic liquid-nitrogen transfer system, capable of delivering in the order of 30 liters of liquid nitrogen per minute, now in use at the Brookhaven Graphite Research Reactor. Author

18 MATERIALS, METALLIC

Includes: cermets; mechanical and physical properties of alloys and metals; and metallurgy.

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Non-metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-11975 Hanford Atomic Products Operation, Richland, Wash.
CREEP PROPERTIES OF ZIRCALOY-2 FOR DESIGN APPLICATION
P. J. Pankaskie Oct. 10, 1962 27 p 8 refs
(Contract AF(45-1)-1350)
(HW-75267)

Long-term (circa 10,000 hours) creep data for constant load and temperature, and temperature and load cyclic conditions have been obtained for Zircaloy-2 in the annealed and 15% cold-worked condition. In the annealed condition, creep behavior is substantially influenced by strain-age-hardening phenomena. In the 15% cold-worked condition, creep behavior is very regular and predictable, and for this reason, should be employed in general design applications. Author

N63-12021 Joint Publications Research Service, Washington, D.C.
CHROMIUM CARBIDE-BASE ALLOYS
V. V. Hryhor'eva and V. M. Klymenko Jan. 24, 1963 127 p 55 refs Transl. of the monograph "Splavy na Osnovi Karbidu Khromu" Kiev, Ukrain. SSR Acad. of Sci. Publishing House, 1961 56 p
(JPRS-17275) OTS: $10.10

Investigations of chromium carbide-base alloys include: the properties of chromium carbides per se; technology of manufacture, properties, and application of the alloys. I.v.L.

N63-12027 Aerospace Information Div., Library of Congress, Washington, D.C.
AUSFORMING BY EXTRUSION
Jan. 9, 1963 2 p Review of: Yu. N. Kabanov, N. I. Korneyev, S. B. Pevzner, I. G. Skugarev, and V. F. Kalugin Extruded superstrength steel semiproducts Byull. Tech.-Ekon. Informatsii (Moscow), no. 10, 1962 p 37-38
(AID-S-63-5) OTS: $1.10 ph, $0.80 mf

A method of ausforming is described in which a high-strength steel was extruded as a metastable austenite. The steel, melted in an open induction furnace, was preforged into billets. The billets were encased in carbon steel or copper envelopes, 0.5 to 2.5 mm thick, which acted as solid lubricants during extrusion. The billets were extruded at 803° to 853° K on a 1000-ton vertical press. At these temperatures, the steel had a true strength of 150 to 170 kg/mm² and a reduction in area of 80%. The lubricating effect of the envelopes, combined with the low extrusion rates, made it possible to extrude the steel with a specific pressure of 130 to 160 kg/mm² and a reduction as high as 90%. Bars extruded with a 90% reduction had a tensile strength of 280 kg/mm² and an elongation of 6%. Extrusion with a reduction of 50% resulted in a tensile strength of 240 kg/mm² and an elongation of 7.5%. I.v.L.

N63-12056 Purdue U. School of Aeronautical and Engineering Sciences, Lafayette, Ind.

MICROSTRUCTURAL CHANGES PRODUCED IN ORBITED RENE'41 HEAT SHINGLES

John F. Radavich Aug. 1962 15 p

Results of this study are as follows: there was no definite observation of surface markings to indicate obvious meteorite impingements; the outer oxide layer on flown material undergoes an enrichment of Cr_2O_3 relative to preflight material; the amount of M_6C carbide phase in flown material decreases relative to the TiC phase; although the primary grain boundaries appear unaffected, the flown material has considerably heavier secondary grain boundaries, indicating phase reaction occurring because of conditions of flight. The primary γ' has coarsened and a secondary finer γ' has precipitated in the matrix; the low temperature recorded by the thermocouples are normally too low to produce the metal-oxide reactions found in this work; hence, either the instrumentation data is incorrect or the conditions of flight promote phase reactions at much lower temperatures; the solution temperature of 1950° F for one-half hour may be too high and/or too long for this thickness of material since a large amount of the strengthening elements diffuses into a copious oxide layer. Author

N63-12096 Climax Molybdenum Co. of Michigan, Detroit

INVESTIGATION OF MOLYBDENUM- AND TUNGSTEN-BASE ALLOY SHEET MATERIALS Final Report, May 1961 to July 1962

Gordon D. Mc Ardle, Robert Q. Barr, and M. Semchyshen Jan. 15, 1963 148 p 12 refs

(Contract NOw 61-0581-d)

In connection with the broad objectives of the Refractory Metals Sheet Rolling Program, sheet stock nominally 0.05 inches thick by approximately 8 inches wide and 20 inches long has been prepared by several working schedules representing the following refractory alloys: (1) Mo + 1.35% Cb + 0.028% C; (2) Mo + 1.17% Ti + 0.27% Zr + 0.15% C; (3) Mo + 25.4% W + 0.10% Zr + 0.037% C; (4) Mo + 49.1% W + 0.014% C; and (5) W + 3.5% Mo + 0.015% C.

Adequate recoveries of sound stock were obtained for the first three alloys listed; the yield of sound rolled sheet from the 50 Mo-50 W and W + 3.5% Mo alloys were, however, rather low. The Mo + 1.17% Ti + 0.27% Zr + 0.15% C (TZC) and Mo + 25.4% W + 0.10% Zr + 0.037% C (WZM) alloys both displayed good combinations of recrystallization, strength, and ductility characteristics, and are recommended as prime candidates for inclusion in future pilot development or preproduction development programs. Author

N63-12129 Pennsylvania U., Philadelphia

TEMPERATURE DEPENDENCE OF THE YIELD POINTS IN IRON Technical Report

R. A. Ekvall and Norman Brown Feb. 16, 1962 15 refs

(Contract Nonr-551(20))

Between 300° and 90° K the elastic limit and the anelastic limit were measured in polycrystalline irons with .0014% and .012% interstitial impurities using a high sensitivity extensometer. The elastic limit was independent of temperature but depended on purity. The anelastic limit depended on temperature and impurity content, but the decrease in temperature dependence with decreasing amount of impurity indicated that an ultrapure iron should show no temperature dependence of the anelastic limit as measured with a high sensitivity extensometer. These results do not support the existence of a temperature-dependent Peierls-Nabarro Force in iron. The large temperature dependence ordinarily associated with the macroscopic measurements of the yield point was shown to be associated with the rate of work hardening in the microstrain region, i.e., between our anelastic limit and the macroscopic yield point. The rate of work hardening in the microstrain region increases markedly with decreasing temperature. It was concluded that only thermally activated cross-slip would determine the temperature dependence of the macroscopic yield point if impurities could be completely eliminated. Author

N63-12134 Joint Publications Research Service, Washington, D.C.

PRODUCTION AND PROPERTIES OF SEMI-FINISHED TANTALUM

Jeri Vacek Jan. 25, 1963 32 p 21 refs Transl. from Neue Huette (Leipzig), v. 2, no. 11, Nov. 1957 p 692-702

(JPRS-17296) OTS: $3.60

The report describes the author's experiments: compaction of powdered tantalum, sintering, sintering installation, vacuum measurement, temperature measurement, influence of sintering temperature and duration, spectrum analysis of exhaust gases, increase of temperature during sintering, full-scale vacuum installation, working of sintered bars, waste recovery; and some properties of semifinished tantalum products. Author

N63-12136 Joint Publications Research Service, Washington, D.C.

SEMINAR. PRODUCTION METHODS, PHYSICAL PROPERTIES, AND ELECTRONIC STRUCTURE OF THE REFRACTORY METALS, THEIR COMPOUNDS AND ALLOYS. SUMMARIES OF REPORTS

A. A. Matveychuk, ed. Jan. 28, 1963 58 p Transl. of the book "Seminar—Metody Polucheniya, Fizicheskiye Svoystva i Elektronnoye Stroyeniye Tugoplavkikh Metallov, Ikh Soyedineniy i Splavov—Tezisy Dokladov" Kiev, Acad. of Sci. Ukrainian SSR, 1961 p 1-64

(JPRS-17322) OTS: $5.60

N63-12166 Massachusetts Inst. of Tech. Metals Processing Lab., Cambridge

THE STRENGTH AND PLASTICITY OF ANISOTROPIC METALS First Quarterly Report

W. A. Backofen and W. F. Hosford, Jr. Watertown, Mass., Army Materials Research Agency, Sept. 30, 1962 17 p refs

(DA-19-020-ORD-5719)

(WAL-TR-834.12/2)

Effort was devoted to preparation of a paper, "Strength and Plasticity of Textured Metals," presented at the Ninth Sagamore Ordnance Materials Research Conference on "Fundamentals of Deformation Processing." Emphasis was placed on the role of plastic anisotropy in determining the behavior of textured metals in applications involving combined-stress loading, as well as the possibilities of property improvement through texture control. Initial experimental results in plane strain are presented for several materials. In general, these have given good agreement with predictions from anisotropic continuum theory. Author

N63-12176 Bureau of Mines. Albany Metallurgy Research Center, Ore.

THERMODYNAMIC PROPERTIES OF YTTRIUM METAL AND IRON PENTACARBONYL AT HIGH TEMPERATURES

James R. Welty, Charles E. Wicks, and Herbert O. Boren 1963 14 p 5 refs
(BM-RI-6155)

Heat content values were experimentally determined for yttrium metal between temperatures of 400° and 1,300° K and for iron pentacarbonyl between 301° and 380° K. The drop technique was used; that is, a sample of material sealed in a protective capsule was heated to a desired temperature in a furnace, then dropped into an ice calorimeter. A revised technique for determining heat content values from calorimetric data is described. Heat content and corresponding entropy-increment data above a reference temperature of 298.15° K are presented in tabular form. Equations for heat content and heat capacity as functions of temperature were derived for each substance. Author

N63-12177 General Electric Co. Flight Propulsion Lab. Dept., Cincinnati, Ohio

REFRACTORY MATERIALS RESEARCH Ninth Quarterly Progress Report (1 October 1962 to 31 December 1962)

G. M. Kibler, T. F. Lyon, M. J. Linevsky, and V. J. De Santis Dec. 31, 1962 47 p 8 refs
(Contract AF 33(616)-6841; ARPA Order 24-62)

Concurrently with the design and fabrication of apparatus modifications to be used in studying evaporation of borides, an additional series of measurements of the rate of nitrogen effusion from a Knudsen cell containing HfN was made, and two additional series of measurements in the Ta-N high nitrogen content region have also been completed. The HfN results provide further evidence that the orifice effects noticed are due to diffusion limitations rather than to a nonunit evaporation coefficient. Nitrogen pressures computed from effusion rates from Ta-N compositions have been found to differ widely from one series to another in the region of 33 to 48 percent nitrogen. Since no unusual or unstable phases have been found, no satisfactory explanation can be given, at present, for this behavior. Author

N63-12186 Joint Publications Research Service, Washington, D.C.

TRANSLATIONS OF CHEMISTRY IN THE USSR (SOVIET NONFERROUS METALLURGY)

Jan. 25, 1962 23 p 6 refs Transl. of 2 articles from Izvest. Vyssh. Ucheb. Zaved., Chern. Metallurg. (Moscow), v. 5, no. 9, 1962 p 160-164 and 197-205
(JPRS-17306) OTS: $2.60

CONTENTS:

1. STRUCTURAL CHANGES DURING HARDENING AND RECRYSTALLIZATION OF MOLYBDENUM A. P. Gulyayev, S. S. Gorelik, and M. S. Sen'kina p 1-7 4 refs (See N63-12187 05-18)
2. COMBUSTIBILITY OF TITANIUM AND ITS ALLOYS N. V. Manuyev p 8-20 2 refs (See N63-12188 05-18)

N63-12187 Joint Publications Research Service, Washington, D.C.

STRUCTURAL CHANGES DURING HARDENING AND RECRYSTALLIZATION OF MOLYBDENUM

A. P. Gulyayev, S. S. Gorelik, and M. S. Sen'kina *In its* Transl. on Chem. in the USSR (Sov. Nonferr. Metall.) Jan. 25, 1963 p 1-7 4 refs (See N63-12186 05-18) OTS: $2.60

Structural changes during the deformation and subsequent tempering of cast molybdenum and the influences of these changes upon hardening and rehardening were investigated. Molybdenum filed into a powder was also analyzed for structural changes. Results were compared with those for iron obtained under similar conditions. I.v.L.

N63-12188 Joint Publications Research Service, Washington, D.C.

COMBUSTIBILITY OF TITANIUM AND ITS ALLOYS

N. V. Manuyev *In its* Transl. on Chem. in the USSR (Sov. Nonferr. Metallurg.) Jan. 25, 1963 p 8-20 2 refs (See N63-12186 05-18) OTS: $2.60

The explosion safety conditions for the processing of powders of titanium and titanium-manganese and titanium-aluminum alloys are investigated. Results are presented for: (1) the temperature of autocombustion; (2) lower concentration limit of detonation; and (3) pressure and temperature of detonation. I.v.L.

N63-12212 Sandia Corp., Albuquerque, N. Mex.

THREE LOW-PRESSURE SPALL THRESHOLDS IN COPPER

J. H. Smith Jan. 1963 27 p 24 refs
(Sponsored by AEC)
(SC-4747(RR)) OTS: $0.75

Measured values of the three low-pressure spall thresholds in a copper plate are presented. The two lower thresholds are original with this program. However, the incipient spall threshold or beginning of tensile damage corresponds rather closely in magnitude to the dynamic elastic yield strength of copper in compression. The complete spall threshold corresponds to the value determined by Rinehart for copper. Thresholds are presented in terms of pressure and pulse width, and the effect of varying the pulse width with a given pressure is shown. The experimental methods, including properties of the compressed-air gun, are discussed since they are applicable to most metals and many nonmetals. Author

N63-12225 Joint Publications Research Service, Washington, D.C.

SOVIET STUDIES ON CRYSTAL STRUCTURE

Jan. 30, 1963 37 p 36 refs Transl. of four articles from the book "Issledovaniya po Zharoprochnym Splavam, Vol. 4" Moscow, Publishing House of the Academy of Sciences USSR, 1959
(JPRS-17370) OTS: $1.00

CONTENTS:

1. THE ROLE OF SEPARATION SURFACES IN THE DELAYED FRACTURE OF METALS I. A. Oding, V. S. Ivanova, and Yu. P. Liberov p 1-12 20 refs (See N63-12226 05-18)
2. EFFECT OF CRYSTAL STRUCTURE DEFECTS ON CERTAIN PROPERTIES OF METALS AND ALLOYS I. Ya. Dekhtyar, V. S. Mikhalenkov, and E. G. Madatova p 13-23 11 refs (See N63-12227 05-18)
3. EXPERIMENTAL OBSERVATION OF SOURCES OF DISLOCATIONS ON THE BASIS OF SEPARATIONS V. G. Rakin and N. N. Buynov p 24-28 5 refs (See N63-12228 05-18)
4. STUDY OF SUBMICROSCOPIC DEFECTS IN METALS BY THE METHOD OF X-RAY BEAM SCATTERING AT LOW ANGLES S. N. Zhurkov and A. I. Slutzker p 29-34 (See N63-12229 05-18)

N63-12226 Joint Publications Research Service, Washington, D. C.

THE ROLE OF SEPARATION SURFACES IN THE DELAYED FRACTURE OF METALS

I. A. Oding, V. S. Ivanova, and Yu. P. Liberov *In its* Soviet Studies on Crystal Structure Jan. 30, 1963 p 1-12 20 refs (See N63-12225 05-18) OTS: $1.00

The role of vacancy formation and transition in the process of delayed fracture of metals was investigated by electron microscopy. Analyses of microphotographs of heat resistant steels stressed at high temperatures for long times indicate that vacancies migrate by autodiffusion and form stable colonies at grain, block and twin boundaries, and sliding surfaces. Fields of force implement this process in areas which are experiencing compression stresses. In alloys with unstable structures, the precipitation and coagulation of secondary phases may contribute to deterioration, but the delayed fracture of stable alloys is attributed to the vacancy migration process. M.P.G.

N63-12227 Joint Publications Research Service, Washington, D.C.

EFFECT OF CRYSTAL STRUCTURE DEFECTS ON CERTAIN PROPERTIES OF METALS AND ALLOYS

I. Ya. Dekhtyar, V. S. Mikhalenkov, and E. G. Madatova *In its* Soviet Studies on Crystal Structure Jan. 30, 1963 p 13-23 11 refs (See N63-12225 05-18) OTS: $1.00

The relationships between crystal structure defects, deformation stress, and the properties of metals are examined. Two studies were made to investigate the hypothesis that the interaction of the defects and their change of state and distribution is the result of deformation: (1) a study of plastic deformation during repeated hardening of various metals, and (2) a study of the effect of plastic deformation on the diffusion rate of nickel alloys. Both studies confirmed that dislocation-type defects are displaced in the plastic deformation of metals at high temperatures. M.P.G.

N63-12228 Joint Publications Research Service, Washington, D.C.
EXPERIMENTAL OBSERVATION OF SOURCES OF DISLOCATIONS ON THE BASIS OF SEPARATIONS
V. G. Rakin and N. N. Buynov *In its* Soviet Studies on Crystal Structure Jan. 31, 1963 p 24-28 5 refs (See N63-12225 05-18) OTS: $1.00

The sources of metallic dislocations were investigated by electron microscopy. Chains of separations in the form of nearly closed continuous or broken loops were observed in an Al-Cu alloy sample aged at 190° for 4 hours, and at 250° for 30 minutes. These loops were apparently produced as a result of the formation and growth of separations at dislocations; the surface orientation of most of these loops was on the (111) plane. The loops exhibit a center opening whose nature has not been determined, but whose size is an indication of the length of the source. M.P.G.

N63-12229 Joint Publications Research Service, Washington, D.C.
STUDY OF SUBMICROSCOPIC DEFECTS IN METALS BY THE METHOD OF X-RAY BEAM SCATTERING AT LOW ANGLES
S. N. Zhurkov and A. I. Slutzker *In its* Soviet Studies on Crystal Structure Jan. 31, 1963 p 29-34 (See N63-12225 05-18) OTS: $1.00

The irregularities in electron density of metallic crystals were investigated by a method based on X-ray beam scattering at small angles. In this method, the angular function and the intensity of the scattered beam is used to calculate the dimensions, concentrations, shapes, and orientations of the irregularities. The stability of the scatter observed for annealed aluminum and annealed nickel indicated that the irregularities are empty spaces or fissures in the metal. These studies also indicated that the greatest change in submicroporosity occurs during the early stage of deformation. M.P.G.

N63-12261 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE SPUTTERING OF COOPER BY N_2^+ AS A FUNCTION OF PRESSURE AND TEMPERATURE
Thomas W. Snouse and Michael Bader Repr. from 1961 Transl. of the 8th Vacuum Symp. and 2nd Intern. Cong., Oxford, London, New York, Pergamon Press, 1962 p 271-274 2 refs

Sputtering yields of copper under bombardment by mass-analyzed beams of N_2^+ have been measured at 3 KeV as a function of the target-chamber background pressure (3×10^{-3}–5×10^{-8} Torr) and the target temperature (60° to 475° C). A specially designed ultrahigh vacuum system made it possible to control the background pressure independently of the beam current. The target temperature at the beam spot was controlled independently of the beam current density. The results are discussed in terms of sputtering mechanisms. Author

N63-12276 Westinghouse Electric Corp., Bloomfield, N.J.
PHYSICAL METALLURGY OF TUNGSTEN AND TUNGSTEN BASE ALLOYS [Interim] Technical Report [April 1, 1961 to March 31, 1962]
Heinz G. Sell, George H. Keith, Ronald C. Koo, Randolph H. Schnitzel, and Richard Corth Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Nov. 1962 218 p 111 refs
(Contract AF 33(616)-6933)
(WADD-TR-60-37, Pt. III)

The tensile properties of polycrystalline tungsten were investigated. Ductility decreases between 2000° F and 4000° F, and it was found that annealing temperature has a greater effect on the transition temperature than does grain size. Single crystals with a [100] orientation were grown by electron-beam floating-zone melting. The tensile deformation behavior of these crystals was studied from −196° C to 800° C. Internal friction measurements were made on single crystals between 20° C and 600° C and it was attempted to correlate damping peaks found at about 300° C and 475° C with interstitial effects, carbon dosing experiments, and yield point phenomena. Single crystals were worked by rolling, and their recrystallization response was investigated as a function of cold work and working temperature. Twin morphology was thoroughly studied. Binary solid solution alloy single crystals of W-Ta were produced by electron-beam floating-zone melting from compacted ingots. Alloy single crystals containing .25% and 4% tantalum were worked, and the recrystallization response was determined to be 400° C to 600° C higher than that of worked pure tungsten single crystals. The tensile strength of sintered and swaged W-TaC alloys was determined at 3000° F and 3500° F as a function of alloy composition (0.1 to 1%). Also measured at 3000° F and 3500° F were the tensile strengths of the systems W-2%ThO_2 and W-.5%HfO_2. Author

N63-12278 Southern Research Inst., Birmingham, Ala.
THE FRICTIONAL CHARACTERISTICS OF VARIOUS ALLOYS AND COATINGS AT ELEVATED TEMPERATURES Report to Lawrence Radiation Laboratory
Herman L. Lessley and Clifford L. Dotson Washington, AEC Div. of Tech. Information, Sept. 21, 1962 187 p
(LRL Order 9667107)
(Rept. 5491-1336-XI; UCRL-13052) OTS: $2.75

The reciprocating frictional characteristics of various combinations of three nickel-base alloys, two ceramic materials, and 26 coating materials were determined at different temperatures ranging from room temperature to 1400° F for periods of one hour. The length of stroke (0.5 in.) and reciprocating frequency (8.8 cpm) were constant throughout the program. The purpose of the work was to provide data needed by Lawrence Radiation Laboratory in conjunction with their research and development for the Atomic Energy Commission.

Among the coated materials, there was no consistent effect of temperature on the coefficient of friction. For the ceramic materials, the coefficient tended to increase with increasing temperature; and for the uncoated metals, the coefficient of friction tended to remain constant or to decrease with increasing temperature. In the Rene' 41, for example, the average dynamic coefficient of friction decreased from about 0.60° at room temperature to about 0.30° at 1400° F. Author

N63-12284 Pratt and Whitney Aircraft, Middletown, Conn.
WORK HARDENING MECHANISMS IN BODY CENTERED CUBIC METALS Technical Documentary Report [Feb. 1, 1961—Jan. 31, 1962]
Donald P. Gregory, George H. Rowe, and Alan N. Stroh Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Sept. 1962 131 p 85 refs
(Contract AF 33(616)-7855)
(ASD-TDR-62-354)

Analysis of a literature survey indicates that the following five properties are important in governing the dislocation arrangement, and hence the work hardening mechanism, in a particular metal crystal: (1) number of slip systems and slip directions; (2) possibility of dislocation interactions to produce Lomer-Cottrell type barriers; (3) extension of dislocations, stacking-fault energy (ease of climb and cross slip, formation of edge dipoles and elongated loops during deformation, multiplication of dislocations by double cross slip); (4) energy to form lattice vacancies or interstitial atoms by nonconservative motion of jogs in screw dislocations compared to the energy for conservative motion of the jogs along screw dislocations

(whether or not point defects are formed during deformation); and (5) impurity atom-dislocation interactions (locking of sources). Results of an experimental work hardening program with polycrystalline and single crystal columbium are described. The columbium consisted of polycrystalline material of nominal impurity content in a variety of conditions ranging from wrought, recovered, fine-grain and coarse-grain and electron-beam zone refined single crystals. Work hardening in fine grain columbium polycrystals containing several hundred ppm interstitial impurity at 50° C results from a decrease in both the number of mobile dislocations and the activation volume with increasing strain. The particular mechanism responsible for work hardening appears to be nonconservative motion of jogs in screw dislocations which results in the formation of lattice vacancies. Author

N63-12285 Climax Molybdenum Co. of Michigan, Detroit

DEVELOPMENT OF WORKABLE MOLYBDENUM- AND TUNGSTEN-BASE ALLOYS Technical Documentary Report [Feb. 1961—Feb. 1962]

M. Semchyshen, Robert Q. Barr, and G. G. Chesmar Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, June 1962 79 p 7 refs
(Contract AF 33(616)-7930)
(ASD-TDR-62-508)

A number of complex molybdenum-, molybdenum-tungsten-, and tungsten-base alloys have been consolidated by the vacuum-arc-casting technique. Difficulty was experienced in obtaining sound castings of alloys based on varying molybdenum/tungsten ratios and containing nominally 1.25% titanium and 0.3% zirconium. No difficulties were experienced when the zirconium content was reduced to 0.1% in alloys of this category. Extrusion constants well above those of earlier experiments were measured, indicative of the good elevated-temperature strength and concomitant high resistance to extrusion of the materials studied. A carbon synergism was studied in the alloys Mo + 3% Ti + 0.5% Zr and Mo + 25% W + 1.25% Ti + 0.1% Zr. In the case of both alloys, the carbon contents yielding the highest elevated-temperature strengths also resulted in the highest transition temperatures as measured by the tensile test. An alloy based on Mo-50% W, and containing 0.8% titanium and 0.3% zirconium, displayed exceptionally high strengths at elevated temperatures. The tensile transition temperature of this material was, however, above room temperature. Author

N63-12286 Crucible Steel Co. of America, Pittsburgh, Pa.

DEVELOPMENT OF IMPROVED VANADIUM-BASE ALLOYS FOR ELEVATED-TEMPERATURE USE Technical Documentary Report [May 1, 1960 - Apr. 31, 1962]

V. C. Petersen and H. B. Bomberger Wright-Patterson AFB, Ohio, Directorate of Materials and Processes, Oct. 1962 75 p 19 refs
(Contract AF 33(616)-7288)
(ASD-TDR-62-667)

Work was performed to develop vanadium-base alloys having improved mechanical properties at elevated temperatures. Screening criteria included density-corrected hot hardness at 1800° F and forgeability performance at 2300° F. The validity of hot hardness as a hot strength parameter was established by a correlation with hot-strength data. One hundred and seventy-four binary and multi-addition alloys were levitation-melted in 10-gram charges. Microstructure, forgeability, and hot-hardness data on these alloys are presented. Screening data (rollability, hot hardness, and hot-tensile properties) on larger melts showed the following three compositions to be superior in performance: V-20Cb-5Ti-1Mo-0.1C, V-25Mo-2.5 Hf, and V-35Cr-1Zr. These three alloys demonstrated better forgeability and superior 2000° F tensile strength than the well-known V-20Cb-5Ti composition. Author

N63-12296 Defense Metals Information Center, Battelle Memorial Inst., Columbus, Ohio

REPORT ON MEETING TO REVIEW MARAGING STEEL PRODUCTS

A. M. Hall Dec. 28, 1962 29 p
(Contract AF 33(616)-7747)
(DMIC-MEMO-162)

A meeting was held to review the technical progress which has been achieved on the low-carbon high-nickel maraging steels. Much of the effort in current maraging steel programs is being channeled into the following: an exploration of the nature and behavior of these steels; developing information on properties and on factors influencing these properties; studying the forming, machining, and welding of these steels and the influence of these processes on mechanical properties. The 18 Ni (250) and 18 Ni (300) steels are considered to be superior to the 20 Ni and 25 Ni steels in fracture toughness. Rocket motor-case applications are receiving particular attention, specifically, those concerned with the extra large boosters. D.B.

N63-12304 Massachusetts Inst. of Tech., Cambridge

DYNAMICS OF WETTING IN BRAZING AND SOLDERING

Clyde M. Adams, Jr. July 1962 48 p 1 ref
(Contract DA-19-020-505-ORD-4917)
(WAL-TR-650/1)

The spreading by wetting of some liquid metals on substantially clean solid surfaces is a two-speed process with the rate of spreading related to contact angle, oxygen traces, and solid-state surface alloying. Author

N63-12308 Directorate of Materials and Processes, Aeronautical Systems Div., Wright-Patterson AFB, Ohio

A COMPUTER PROGRAM FOR THE MATANO ANALYSIS OF BINARY DIFFUSION DATA [Final] Technical Documentary Report

Craig S. Hartley and Kenneth Hubbard Nov. 1962 69 p 10 refs
(ASD-TDR-62-858)

A computer program for the Boltzmann-Matano solution to Fick's second law in semi-infinite binary diffusion couples is presented. The program is written in FORTRAN for the IBM-7090 digital computer. An error function curve fit is used to interpolate between and smooth experimental data, and the calculations performed on the regenerated data. Examples are given of application of the program to incremental couples with no intermediate phases, and to pure metal couples with and without intermediate phases. Phase boundaries in couples with intermediate phases can also be obtained with a high degree of accuracy. By substituting lattice spacings for ordinary distance units, a correction for molal volume change due to composition differences can be programed. Author

N63-12309 Directorate of Materials and Processes, Aeronautical Systems Div., Wright-Patterson AFB, Ohio

DISLOCATION PINNING EFFECTS IN UNALLOYED MOLYBDENUM [Final] Technical Documentary Report [Dec. 1960-July 1961]

C. S. Hartley and R. J. Wilson Nov. 1962 34 p 23 refs
(ASD-TDR-62-859)

The rate of yield-point return and modulus-defect recovery is studied in powder metallurgical and arc-cast molybdenum, respectively. The activation energy for yield-point return is found to be 25,100 ± 2700 cal/mol, and is believed to be due to pinning of deformation-produced free dislocations by interstitial oxygen or nitrogen atoms. A calculation of the number of impurity atoms per unit length of dislocation line necessary to cause yield-point return suggests that this pinning is effected by the formation of microprecipitates. Possible mechanisms consistent with this idea which exhibit kinetics similar to the Cottrell-Bilby "atmosphere" theory are discussed. Recovery of the modulus defect is shown to be controlled by the diffusion of the slowest pinning defect. The activation energy for diffusion of the slowest defect calculated from a treatment based on the Granato-Hikata-Lucke theory of point-defect pinning is 44,300 ± 8000 cal/mol. It is suggested that this defect is carbon. Author

N63-12315 Rensselaer Polytechnic Inst., Troy, N.Y.
DISLOCATION MOBILITY AND INTERACTIONS IN HIGH PURITY MAGNESIUM Interim Technical Report No. 1
M. J. Roblin and G. S. Ansell Jan. 1, 1963 138 p 77 refs
(Grant DA-ARO(D)31-124-G209)
(AROD-3394-1)

Transmission electron microscopy was utilized to study the role of crystal structure upon slip, as a plastic deformation process, in high-purity polycrystalline thin foils of magnesium. The effect of stress on the mobility of wholly contained basal dislocations was investigated, using sequential and cine photography. A relationship was derived for such dislocations moving through the lattice with a constant velocity, and it was utilized to show that the applied stress is not related to the velocity as reported by previous investigators. A method of determining the lattice resistance stress was put forth for a specialized case of a moving dislocation array. The operating slip planes were investigated by observation of moving dislocations or their traces, coupled with selected area diffraction. The diffraction patterns which were solved for the determination of the operating slip planes provided information about the plane of the foil surface. An unusual recrystallization texture was noted, and the information was plotted on a standard stereographic triangle. Simple twist boundaries were observed which provided information about the stacking-fault energy of magnesium. Dislocation tangles have been observed in many other metals and generally occur in thicker sections of the foils where the image forces are reduced. This was found to be true for magnesium. Author

19 MATERIALS, NONMETALLIC

Includes: mechanical and physical properties of non-metals (e.g., plastics).

For related information see: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N63-11996 California U., Livermore. Lawrence Radiation Lab.
PROPERTIES OF BeO CERAMICS AND THEIR APPLICATION IN A NUCLEAR PROPULSION SYSTEM (PLUTO)
Albert J. Rothman Sept. 13, 1962 35 p 26 refs
(Contract W-7405-eng-48)
(UCRL-6743) OTS: $0.75

Air-breathing nuclear ramjet engines set rigid requirements on materials. One such nuclear reactor is Project Pluto. A typical reactor is portrayed, and the reasons for ceramic materials requirements are given. A good neutron moderator is necessary for minimum frontal area (and hence drag). Beryllium oxide is the logical choice of moderator, and BeO-UO_2 is the logical fuel element. The properties of BeO are considered in the light of the demands of such a system and compared generally with those of other oxides. Among the properties considered are strength, thermal stress resistance, and thermal conductivity. Some limitations are pointed out, e.g., reaction of BeO with water vapor, and oxidation susceptibility of UO_2. These, in turn, demand development of coatings to resist water attack and other components to stabilize the fuel against disruptive transformation. Author

N63-11999 California U., Berkeley. Lawrence Radiation Lab.
MECHANICAL BEHAVIOR OF SINGLE AND POLYCRYSTALLINE CESIUM BROMIDE
Lawrence D. Johnson Sept. 12, 1962 98 p 24 refs
(Contract W-7405-eng-48)
(UCRL-10468) OTS: $2.00

Plastic-deformation experiments were conducted on cesium bromide, a material that lacks cleavage planes, to study the effect of the absence of cleavage on the mechanical behavior. Observations were made and theories were proposed concerning the mechanisms of plastic deformation and fracture in cesium bromide. Single-crystal cesium bromide was found to be soft and ductile if it was favorably oriented relative to the loading axis to activate the {110}⟨100⟩ slip systems. Kink bands were formed by directing a compression load normal to the {100} system of planes. Cross-slip was found to occur during deformation at all test temperatures. Tensile and bending loads directed normal to {100} and {110} planes caused fracture on {110} planes, while compressive loads normal to {100} planes forced fracture on {112} planes rather than {110} planes. The ductility of polycrystalline cesium bromide was found to decrease for samples with smaller grain sizes. The absence of a sufficient number of slip systems in the specimens may have been responsible for this plastic behavior. The mechanism of fracture was intergranular in polycrystalline cesium bromide. Author

N63-12006 Northwestern Technological Inst., Evanston, Ill.
DISLOCATIONS IN RUTILE AS REVEALED BY THE ETCH-PIT TECHNIQUE Technical Report No. 2
W. M. Hirthe (Ph. D. Thesis) and J. O. Brittain Jan. 16, 1963 Repr. from J. Am. Ceram. Soc., v. 45, no. 11, Nov. 1962 p 546-554
(Contract Nonr-1228(17))

Potassium hydroxide and sodium hydroxide were found to be satisfactory for polishing various surfaces of rutile. Dislocation etch pits could be produced by alkali fusions, 85% orthophosphoric acid, and concentrated sulfuric acid. The {110}-, near {111}-, (001)-, and {100}-type surfaces were etched and the etch pits were analyzed in terms of their relation to the deformation systems and crystal symmetry. The correlation between etch pits and dislocations was substantiated by means of matched cleavage surfaces, existence of substructures, generation of dislocations, dislocation densities, and polygonization phenomena. Dislocations were introduced by impacting and macroscopic plastic deformation. Generation of dislocations was observed from 1050° C to as low as room temperature. The slip planes confirmed by means of dislocation traces and slip lines were {110}- and {101}-type planes. The slip direction corresponding to the {110}-type plane was [001], the close-packed direction. The Burgers vector, structure, and motion of dislocations in the edge orientation on the {110} [001] systems were determined by analyzing the crystal structure. The Burgers vector was c [001], the lattice translation vector, and the dislocations did not dissociate into partial dislocations. Another possible slip system was the (100) [010] system. Author

N63-12057 Illinois U., Urbana
ZONE MELTING OF POTASSIUM CHLORIDE Technical Note No. 3
T. M. Srinivasan Dec. 1962 16 p 8 refs
(Contract AF 49(638)-529)

Zone refining of potassium chloride crystals produced crystals of a purity superior to that commercially available. Prior to refining, the salt was baked in an atmosphere of chlorine gas. Zone refining was carried out in silica crucibles in an atmosphere of chlorine gas to prevent adhesion of the salt to the crucibles. The purity obtained depended upon the number of zones passed through the salt ingot; but little improvement was noted if more than ten passes were used. The purity of the salt was measured by ionic conductivity. I.v.L.

N63-12069 Rocketdyne, Canoga Park, Calif.
FINAL REPORT, PROGRAM OF TESTING NONMETALLIC MATERIALS AT CRYOGENIC TEMPERATURES [Feb. 1961-Sept. 1962]
R. E. Mowers, comp. Dec. 30, 1962 167 p 21 refs
(Contract AF 04(611)-6354)
(R-3498)

The tensile yield strength, ultimate tensile strength, tensile modulus, ultimate flexural strength, flexural modulus, ultimate compressive strength, compressive modulus, impact strength, modulus of rigidity, and coefficient of thermal expansion were determined for several plastic materials at 77° F, -100° F, -200° F, -320° F and -423° F. Materials tested included TFE and FEP Teflon, Kel-F, Mylar, and nylon, as well as fabric- and powder-reinforced TFE and FEP Teflon. The program included the determination of the effect of thermal treatment of certain of the materials on the crystallinity level, and the resultant effect on the mechanical properties. Author

N63-12100 Naval Radiological Defense Lab., San Francisco, Calif.
EFFECT OF CURE UPON CROSS LINKING, CHAIN SCISSION, AND COMPRESSION SET IN AN IRRADIATED RUBBER VULCANIZATE
W. E. Shelberg and J. F. Pestaner Jan. 10, 1962 23 p 6 refs
(USNRDL-TR-547)

A compressed natural rubber vulcanizate was exposed to 10^8 r of gamma radiation and allowed to reach its set length at 40° C after release from compression. Compression set, crosslinking, and scission of the elastomer network varied with degree of cure. The average radiation yield (G) for chain scission and for crosslinking in the dose region from 0 to 10^7 r was 0.75 and 1.3, respectively. 9,10-Phenanthrenequinone and 1,4-naphthoquinone functioned as antirads at 10^8 r and reduced compression set moderately below that predicted from degree of cure. Author

N63-12155 Atomics International, Canoga Park, Calif.
PULSE HEATING OF ZIRCONIUM-URANIUM HYDRIDES
R. E. Taylor, H. G. Weidberg, and R. T. Albee Dec. 30, 1962 28 p 8 refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7398) OTS: $0.50

Apparatus and techniques for measuring power input, electrical resistivity, temperature, and amount and rate of hydrogen released from zirconium-uranium hydrides ($ZrU_{0.04}H_{1.8\pm0.1}$) during transient conditions are described. Data are presented for six samples that were heated to their destruction. Initial heating rates were about 7500° C/sec; however, as hydrogen started evolving, the temperature approached an equilibrium value of about 1200° C. Half of the samples survived until essentially all of their contained hydrogen was evolved. These samples received a total power input which corresponded to about a 130 mw-sec excursion of a reactor containing 108 lb of fuel. Author

N63-12162 New York U. Radiation and Solid State Lab., N. Y.
Status Report, June 1, 1962 to Aug. 31, 1962 [POLARIZATION OF ANTHRACENE CRYSTALS WITH LIQUID ELECTRODES AND PLASTIC HOLDER]
[1962] 7 p
(Contract Nonr285(25))

Measurements on the polarization of anthracene crystals using liquid electrodes were made with a sample holder which increases exposed crystal surface area to about 50% and decreases interference due to holder polarization. Polarization values were obtained up to 2.1×10^{-7} coul/cm^2 when a field of 10^4 volts/cm (1000 volt) was applied with concomitant irradiation falling on the positive electrode for 20 minutes. The dark decay of the polarization charges trapped at the barrier face is extremely small, causing spurious polarization from the holder to be negligible. R.C.M.

N63-12193 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
COMPATIBILITY OF MOLTEN URANIUM DIOXIDE WITH FIVE REFRACTORY MATERIALS
William A. Sanders and Isadore L. Drell Washington, NASA, Jan. 1963 33 p 16 refs
(NASA TN D-1442) OTS: $1.00

The compatibility of molten uranium dioxide with tungsten, tantalum, tantalum diboride, tantalum carbide, and hafnium carbide was determined at 5220° F for a test period of 15 minutes in a static argon atmosphere. Reactions occurred in all cases; however, the use of tungsten, tantalum, or hafnium carbide in contact with molten uranium dioxide appears possible for short time applications. Author

N63-12334 Brookhaven National Lab., Upton, N. Y.
FUNDAMENTAL STUDIES OF RADIATION DAMAGE IN GRAPHITE
Donald G. Schweitzer Apr. 17, 1962 20 p 10 refs
(Sponsored by AEC)
(*Its* Lecture Series 16; BNL-745(T-270)) OTS: $0.50

Irradiation studies have been made on graphite to determine the nuclear reactions involved in radiation damage. The initial irradiation is shown to produce only trapped single interstitials and C_2 molecules and a radiation damage model is developed which is in agreement with the experimental results. Dimensional changes occurring during the anneal indicate that equilibrium reactions between interstitials occur during reirradiations. The assumption of anneal by annihilating vacancies leads to a specific type of reaction releasing stored energy. The stored energy reactions are concluded to be different from the reactions assumed by other investigators. R.C.M.

20 MATHEMATICS

Includes: calculation methods and theory; computers; data processing; and numerical analysis.

For related information see: 08 Communications; 09 Electronics; 10 Facilities; and 22 Navigation and Guidance.

N63-11987 Naval Ordnance Lab., White Oak, Md.
UPPER AND LOWER BOUNDS FOR THE APSIDAL ANGLE IN THE THEORY OF THE HEAVY SYMMETRICAL TOP
J. B. Diaz and F. T. Metcalf Oct. 4, 1962 42 p 22 refs
(Contract AF 49(638)-228)
(NOLTR-62-131; Mathematics Dept. Rept. M-29)

A simple method is developed for obtaining upper and lower bounds for the apsidal angle which occurs in the theory of the heavy symmetrical top. This method is employed to give a quick derivation and an improvement of the upper and lower bounds obtained by W. Kohn. An advantage of the present method is the simplification which arises from eliminating the need for contour integration. The sharpness of the bounds is demonstrated, again without contour integration. The particular method in question is illustrated first in the theory of the spherical pendulum. Author

N63-12008 Stanford Research Inst., Menlo Park, Calif.
NIMBUS DATA-HANDLING SYSTEM First Quarterly Progress Report [7 January 1962 to 7 April 1962]
R. M. Madvig, J. J. Bialik, P. A. Davis, R. M. Endlich, J. H. Jones, M. G. H. Ligda, A. Macovski, R. E. Nagle, A. R. Tobey, and H. M. Zeidler
May 1962 179 p 1 ref
(NASA Contract NAS5-1882)
OTS: $12.50 ph, $5.57 mf

The purpose of this study is to develop an optimum system for processing Nimbus data. The report includes: (1) recommendations for a digital computer system for automatically adding grids (lines of longitude and latitude) to the cloud pictures and to the infrared data; (2) an analysis of the possible positional inaccuracies resulting from

raster shift in the vidicon cameras; (3) an analysis of the separate transmission of picture grids; and (4) a study of the requirements of Nimbus data users. Author

N63-12009 Stanford Research Inst., Menlo Park, Calif.

NIMBUS DATA-HANDLING SYSTEM Second Quarterly Progress Report

R. M. Madvig, J. Jones, M. G. H. Ligda, A. Macovski, S. Serebreny, A. R. Tobey, and H. Zeidler July 1962 107 p 16 refs
(NASA Contract NAS5-1882)
OTS: $9.10 ph, $3.41 mf

The field of bandwidth utilization was evaluated in relation to the transmission of Nimbus data, and it was concluded that digitization of Nimbus pictures cannot, now, be justified on the basis of transmission economy. The study of gridding and rectification of Nimbus pictures proceeded. On-board gridding can be expected to reduce the adverse effects of raster distortion and raster shift in the Vidicon cameras, and a possible method of on-board gridding is described. Although the study of rectification by digital means is far from complete, it is proceeding. Gridding by computer was investigated further with the aim of establishing the absolute accuracy and efficiency of the method. A more detailed description of the interpolation method has been written, and the worst-case error caused by interpolation has been determined. Author

N63-12010 Stanford Research Inst., Menlo Park, Calif.

NIMBUS DATA-HANDLING SYSTEM Third Quarterly Progress Report

R. M. Madvig, M. G. H. Ligda, A. Macovski, J. J. Bialik, and A. R. Tobey Oct. 1962 81 p 6 refs
(NASA Contract NAS5-1882)
OTS: $8.10 ph, $2.63 mf

Some conclusions are made regarding requirements for distribution and processing of cloud pictures. The possible applications of infrared data and possible ways to automatically process the IR data are discussed. Operational applications of Nimbus data, as obtained from a survey of weather-analysis centers and weather-forecasting groups, are reported. A method for rectification of cloud pictures is described, the problems associated with digital rectification are discussed, and the increase of communications cost for transmission of rectified pictures over the cost of transmission of unrectified pictures is reported. The line-leasing costs are estimated for several networks for distributing cloud pictures to United States Weather Bureau agencies. Methods for gridding and rectifying Nimbus cloud pictures on board the satellite are described. Author

N63-12032 Boston U., Mass.

THE TRANSFORMATION BETWEEN CARTESIAN AND CONIC COORDINATES Research Report No. 1

L. Belsky Aug. 1962 40 p 1 ref
(NASA Grant NsG-246-62)
(*Its* Astronom. Contrib., Ser. II, No. 21) OTS: $3.60 ph, $1.40 mf

A solution for the transformation constants between two 2-dimensional systems of coordinates with noncoincident centers of coordinates is obtained. Cartesian and conical coordinate systems were used. Since the coordinates are subject to error, measured coordinates of more than the six required points were necessary. The root mean-square values of the transformation constants were obtained by requiring the difference between the measured and the calculated values of the coordinates to be a minimum. Equations used to prepare the IBM reduction program are given, as well as copies of the program in FORTRAN language as it was fed to the IBM 1620. A short program appears in the FORTRAN statement for processing and printing the data on craters when this procedure is applied to the study of lunar photography. I.v.L.

N63-12037 Stanford U. Applied Mathematics and Statistics Labs., Calif.

ON A PSEUDO-SOLUTION TO A SCHEDULING PROBLEM

S. Zacks 17 p 7 refs
(Contract Nonr-225(52))
(Tech. Rept. 84)

Pseudosolutions, based on an extra assumption concerning the dependence structure among the earliest starting points of operations, are derived by the method of dynamic programing. I.v.L.

N63-12061 National Aeronautics and Space Administration, Washington, D.C.

APPROXIMATE SOLUTION TO A NONLINEAR DIFFERENTIAL EQUATION OF THE THIRD ORDER WITH THE N. N. BOGOLYUBOV ASYMPTOTIC METHOD

A. D. Maksimov Jan. 1963 11 p 5 refs Transl. of "Priblizhennoye Resheniye Nelineyogo Differentsial'nogo Uravneniya Tret'yego Poryadka Asimptoticheskim Metodom N. N. Bogolyubova." Izvest. Akad. Nauk SSSR, Otdel. Tekh. Nauk: Energetika i Avtomatika, (Moscow), 1962, no. 3 p 196-200

The expressions developed have application to the investigation of rapidly damped oscillation processes in systems of the third order. Author

N63-12076 Texas A and M Coll. Activation Analysis Res. Lab., College Station

INVESTIGATIONS IN AUTOMATED ACTIVATION ANALYSIS

Lloyd E. Fite et al Nov. 1, 1962 426 p 113 refs
(NASA Grant NsG-256-62; Contract AT-(40-1)-2671)
(TEES-2671-2; TEES-E63-64) OTS: $5.50

The feasibility of the computer coupled and automatic approach to neutron-activation analysis has been established and two automated systems have been designed. Other areas of research covered include: sampling and sample preparation; flux measurement; detection; capabilities of a gamma-ray spectrometer; control of drift; and a feasibility study of remote lunar analysis. R.C.M.

N63-12088 Stanford U. Applied Mathematics and Statistics Labs., Calif.

SEQUENTIAL TESTS FOR THE MEAN OF A NORMAL DISTRIBUTION II (Large t)

John Breakwell and Herman Chernoff Nov. 27, 1962 19 p 5 refs
(Contract Nonr-225(52))
(Tech. Rept. 83)

Asymptotic expansions are derived for the behavior of the optimal sequential test of whether the unknown drift, μ, of a Wiener Levy process is positive or negative for the case where the process has been observed for a long time. The test is optimal in the sense that it is the Bayes test for the problem where there is an *a priori* normal distribution of μ, the regret for coming to the wrong conclusion is proportional to $|\mu|$, and the cost of observation is constant per unit time. The Bayes procedure is then compared with the best sequential likelihood ratio test. Author

N63-12090 New York U. Courant Inst. of Mathematical Sciences, N.Y.

THE DISCRIMINANT OF HILL'S EQUATION

David L. Jagerman (Ph.D. Thesis) Nov. 1962 47 p 8 refs
(Contract AF 49(638)-229)
(Research Rept. BR-39)

Structure theorems for the discriminant, $\Delta(\omega^2)$, of Hill's differential equation are developed by means of interpolatory function theory (cardinal series representations). A method of solution of Hill's equation is developed yielding an asymptotic expansion of the discriminant for large $|\omega|$ with error term $O(|\omega|^{-\gamma})$. Asymptotic expansions for the eigenvalues λ_n, λ'_n for large n are obtained with error terms

$O(n^{-7})$. Relations between the occurrence of double zeros of the discriminant and the period of the coefficient function in Hill's differential equation are established. A discriminant-like function $D(\omega^2)$ is introduced and an interpolatory function-theoretic structure result is obtained. Author

N63-12092 Canadian Armament Research and Development Establishment, Valcartier

AN ANALOG COMPUTER METHOD FOR ANALYSING A TWO-DIMENSIONAL TRAJECTORY OF A SINGLE-STAGE ROCKET VEHICLE

P. Bourassa and S. Fromovitz Oct. 1962 37 p 3 refs
(CARDE-TM-662/62)

This memorandum describes an analog computer method for analyzing the two dimensional dynamic behavior of a single-stage rocket vehicle. The trajectory was divided into two parts: from launch to burnout time and from burnout time to impact. The first part was analyzed by a Reeves Analog Computer on which provision was made to estimate the effects of fin and thrust misalignment, the position of the center of gravity, and the launcher length for various elevation angles and burning times. The second part, from burnout time to impact, was analyzed mathematically using the computer output data as initial conditions. It was found that the peak altitude was almost independent of burnout time provided the total thrust remained constant, and that a slight thrust or fin misalignment had a marked effect on range. Author

N63-12095 Research Triangle Inst., Durham, N.C.

STUDENT'S t IN A TWO-WAY CLASSIFICATION WITH UNEQUAL VARIANCES Technical Report No. 3

Kay Knight Mazuy and W. S. Connor Jan. 10, 1963 18 p 7 refs
(Grant DA-ARO(D)-31-124-G266)
(SU-56; AROD-2579-13)

This study investigates the two-way classification with n observations per cell, where each cell is determined by one member from each class. It assumes that an observation is a realization of a random variable which is expressed as a sum of fixed effects, the overall mean and effects for the members which determine the cell, and a random error. With respect to the fixed effects, two models are considered: one without interaction and the other with interaction. The random errors are assumed to be statistically independent and normally distributed with means zero. A variance is associated with each member of each class, and the variance of the random errors in a cell is the sum of the variances associated with the members which determine the cell. Accordingly, the random variables for all cells have the same variance within a cell, but differ from cell to cell as determined by simple additive constraints. In order to use Student's t for testing contrasts among effects, it is necessary to find error contrasts which have the same variance as the contrast to be tested and are statistically independent of it and each other. The maximum number of such contrasts is determined and a method for finding them is presented. Author

N63-12127 California U., Los Angeles

I - AND K - KERNELS ON AN ARBITRARY RIEMANN SURFACE

Myron Goldstein Dec. 7, 1962 75 p 15 refs
(Grant DA-ARO(D)-31-124-G40)
(Tech. Rept. 30; AROD-1517-44)

Shiffer's I and k kernels on plane domains to Riemann surfaces are generalized. For the most part this paper is concerned with giving representations of these kernels in terms of principal functions and the capacity function. Also considered are minimum properties of the I and k kernels on both planar and nonplanar Riemann surfaces. An introduction to the theory of square integrable differentials on an open Riemann surface is given. The principal functions are defined on an open surface and their properties briefly investigated. The capacity function is defined on a hyperbolic surface and its connection with the Green's function given. Finally, the I and k kernels are defined and proved to be essentially unique. Author

N63-12141 Melpar, Inc., Falls Church, Va.

INVESTIGATION OF SPEECH PROCESSING STUDIES Scientific Report No. 1 [Sept. 1961-Sept. 1962]

D. M. Early, H. A. Straight, and O. C. King Oct. 1962 82 p
(Contract AF 19(628)-214)
(AFCRL-62-911)

Results of an investigation of speech processing studies are presented. This investigation has been responsible for the continued updating of the capability and flexibility of the voice-data processing system in an attempt to maintain optimum compatibility between the processor and the research effort for which it was intended. (The voice data processing system was designed and developed for the United States Air Force to support research on digital voice communication and evaluation of a speech bandwidth compression technique). Changes such as automatic consolidation of "number of occurrences" and "cumulative amplitude" inputs from rank-ordered tapes, use of the approximation logic for 1-, 2-, and 3-bit spectrum pattern coding, and separation of rank-ordered data into tables of voiced and unvoiced patterns have been successfully incorporated in the processor. Results of a study to determine the optimum operating environmental for the equipment complex are also presented. Author

N63-12142 Pennsylvania U. Moore School of Electrical Engineering, Philadelphia

THE TREE AS A STRATAGEM FOR AUTOMATIC INFORMATION HANDLING Technical Report

Walter I. Landauer Dec. 15, 1962 127 p 22 refs
(Contracts Nonr-551(40) and AF 30(602)-2832)
(Rept. 63-15)

A tree organization of the computer memory is described that renders the automatic storage and retrieval of information in a computer effective. A salient feature of this organization is the capability to store and retrieve data on the basis of their contents rather than their locations. The tree provides the programmer with a stratagem to implement an associatively organized memory in a conventional addressable store. Two tree-building schemes are developed. Their main distinction lies in the method of construction that depends on the a priori order of the data to be stored. A.S.

N63-12152 RIAS. Div. of Martin Co., Baltimore, Md.

A FUNDAMENTAL INEQUALITY FOR FINITE DIFFERENCE EQUATIONS

G. Stephen Jones [1962] 13 p
(NASA Contract NASr-103; Contracts AF 49(638)-382 and Nonr-3693(00))
OTS: $1.60 ph, $0.80 mf

A lemma, which presents an inequality that may be used in the theory of finite difference equations and more general functional equations, in essentially the same capacity as Gronwall's Lemma of inequality is used in the theory of differential equations, is stated and proved. The statement of the lemma is: Let α, f, and K be real-valued functions defined on the interval $[a, b]$ and on this interval let α be nondecreasing, let f be continuous, and let K be continuous and nonnegative. If x is a bounded function on $[a, b]$ and for all t in $[a, b]$,

$$x(t) \leq f(t) + \int_a^t K(\tau)x(\tau)d\alpha(\tau),$$

then

$$x(t) \leq f(t) - \int_a^t f(\tau)d(\exp(\int_\tau^t K(s)d\alpha(s))),$$

for all t in $[a, b]$.

The proof of the lemma is:

$$z(t) \geq -\delta_1 \exp(m_1(\eta(t) - \eta(a))).$$

But δ_1 may be chosen arbitrarily small, so it may be concluded that $z(t) \geq 0$. Therefore, it is proven that $x(t) \leq \omega(t)$, which was the objective, and the new lemma is established. I.v.L.

N63-12173 Los Alamos Scientific Lab., N. Mex.
THE SOLUTION OF THE GENERAL LEAST SQUARES PROBLEM WITH SPECIAL REFERENCE TO HIGH-SPEED COMPUTERS
Paul Mc Williams Jan. 14, 1963 22 p
(Contract W-7405-eng-36)
(LA-2367 Addenda) OTS: $0.50

The changes incorporated in the nonlinear least squares program are outlined, and a condensed guide is given for the data card arrangement. The code is written in FORTRAN language for the IBM-7090 and the Stromberg Carlson 4020 plotter is used for the plot output option. R.C.M.

N63-12215 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
LINEAR ESTIMATION IN STOCHASTIC PROCESSES
A. George Carlton Mar. 1962 86 p 23 refs
(Contracts NORd-7386 and NOw-62-0604-c)
(Bumblebee Rept. 311)

A general theory is developed for obtaining linear estimates, of minimum mean square error, of components of random processes. The fundamental requirement for applying the theory is that the process in question be vector Markov in the wide sense, a requirement typically satisfied exactly and almost invariably satisfied approximately. This estimation theory has considerable advantages over methods of functional analysis in that: (a) it is concerned with vector observation functions which may be time-dependent linear combinations of components of the process; (b) very general nonstationary processes are treated; (c) explicit solutions are obtained without difficulty; (d) linear prediction is an immediate consequence of linear estimation; and (e) estimates are obtained sequentially. In contrast to the typical approach of considering the observation as the sum of a quantity of interest (sometimes called the signal or a linear combination of unknown parameters), together with disturbances (sometimes called noise or errors of observation), the observation is considered a linear combination of components of a vector process, and the best linear estimate of a complete state vector of the sample process is obtained. Author

N63-12259 Los Alamos Scientific Lab., N. Mex.
THE RATH MESHER. A 7090 PROGRAM FOR PREPARING INPUT DATA FOR HEAT CONDUCTION CODES
Richard F. Thomas, Jr. Jan. 22, 1963 37 p 6 refs
(Contract W-7405-eng-36)
(LAMS-2809) OTS: $1.00

This report describes an IBM 7090 code which divides irregularly shaped two-dimensional figures into mesh nodes suitable for use in heat conduction calculations using any of several existing general geometry heat codes. Author

N63-12312 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
A CENTRAL FACILITY FOR RECORDING AND PROCESSING TRANSIENT-TYPE DATA
Richard L. Smith, Charles W. Mealey, Jr., Charles F. Kadow, Arthur D. Brenza, Richard N. Bell, John C. Sturman, and Allen L. Perry
Washington, NASA, Jan. 1963 81 p 1 ref
(NASA TN D-1320) OTS: $2.25

The data system described has the capacity of recording and automatically processing transient-type data in the frequency range of 0 to 10,000 cps. Data are recorded in both analog and digital form on magnetic tape and are processed by either an analog or a digital computer. Special shielded cable is used to transmit the data at low voltage levels from six test facilities over cable lengths up to 7,000 feet. Identification and search features are provided as well as a quick-look feature using a storage-type oscilloscope. The system has been in operation since March 1960. Author

N63-12327 Joint Publications Research Service, Washington, D.C.
APPLICATION OF LINEAR PROGRAMMING IN THE PLANNING OF ASSORTMENT
L. Terekhov Transl. from Planovoe Khoz. Ezhemesyachnyi Politico-Ekon. Zh. Gos. Planovyi Kom. Sov. Min. SSSR (Moscow), no. 11, 1962 p 72-78
(JPRS-17405) OTS: $0.50

The possibilities of applying the techniques of linear programing to the economic problems of planning and forecasting of assortment in production are discussed. The establishment of production procedures with the aid of mathematical methods, particularly linear programing, will improve economic analysis, provide a broader utilization of labor and material resources, and will aid in forecasting the supply-and-demand ratio. A.R.B.

N63-12331 Columbia U., New York, N.Y.
THE USE OF FACTOR ANALYSIS IN THE STATISTICAL ANALYSIS OF MULTIPLE TIME SERIES
T. W. Anderson Brooks AFB, Tex., School of Aerospace Medicine, Nov. 1962 21 p 14 refs
(Contract AF 41(609)-1534)
(SAM-TDR-62-134)

The function of factor analysis in time series analysis is discussed. The relationships between the models in the two approaches are observed, with distinction being drawn between exogenous and endogenous variables. Various approaches are suggested for analyzing multiple-time series by factor analysis. Author

N63-12340 Wisconsin U. Theoretical Chemistry Inst., Madison
AN EXPANSION OF $J_\nu(\nu x)$ IN POWERS OF $(1/\nu)$
C. F. Curtiss Dec. 17, 1962 13 p 4 refs Submitted for Publication
(NASA Grant NsG-275-62)
(WIS-TCI-7, Series 2) OTS: $1.60 ph, $0.80 mf

Series expansions in powers of $(1/\nu)$ of the Bessel function, $J_\nu(\nu x)$, $J_\nu(\nu x)^2$, and the integral of the product of the square with an arbitrary function are developed. Each term in the expansion of $J_\nu(\nu x)$ is a sum of finite number of derivatives of the delta function, $\delta(x-1)$. Each term in the expansion of the square of the Bessel function is a sum of a finite number of derivatives of $g(x^2-1)$, where $g(x)$ is the discontinuous function defined by $g(x) = x^{-\frac{1}{2}}$ for $x \geq 0$ and $g(x) = 0$ for $x < 0$. Each term in the expansion of the integral is a finite number of integrals involving derivatives of the arbitrary function. Author

N63-12345 Oak Ridge National Lab., Tenn.
CASPER: A GENERALIZED PROGRAM FOR PLOTTING AND SCALING DATA
M. P. Lietzke and R. E. Smith Jan. 30, 1963 32 p
(Contract W-7405-eng-26)
(ORNL-3394) OTS: $0.75

A FORTRAN subroutine has been written to scale floating-point data and generate a magnetic tape to plot it on the Calcomp-570 digital plotter. The routine permits a great deal of flexibility, and may be used with any type of FORTRAN or FAP calling program. A simple calling program has also been written to permit the user to read in data from cards and plot it without any additional programming. Author

21 METEOROLOGY

Includes: climatology; weather forecasting; lower atmosphere studies; and oceanography.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N63-11965 Texas A. and M. Research Foundation, College Station
VERTICAL MOTION CALCULATIONS AND SATELLITE CLOUD OBSERVATIONS OVER THE WESTERN AND CENTRAL UNITED STATES Scientific Report No. 2
John Hansen and Aylmer H. Thompson Jan. 2, 1963 38 p 13 refs
(Contract AF 19(604)-8450)
(AFCRL-62-1094)

Vertical motions over the Western and Central United States during a three-day period in August, 1961, were computed by several methods. The resulting analyses, applicable at 700 mb or 10,000 ft. were compared, both subjectively and objectively, to each other and to approximately synoptic TIROS nephanalyses. The results of the comparisons showed only moderate agreement among the various methods and between the vertical-motion analyses and the TIROS information. The kinematic method, based on observed winds, appeared to give the best agreement with the satellite-picture indications of vertical motion, though it seemed little better than some of the other methods. The use of satellite data shows definite promise as a means of evaluating computed vertical-motion fields, and should eventually contribute to the improvement of the procedures used to compute vertical motions. Author

N63-12003 National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MONTHLY AND ANNUAL WIND DISTRIBUTIONS AS A FUNCTION OF ALTITUDE FOR SANTA MONICA, CALIFORNIA (PACIFIC MISSILE RANGE)
J. W. Smith Washington, NASA, Jan. 1963 157 p 16 refs
(NASA TN D-1569) OTS: $3.00

Statistical wind distributions for Santa Monica, California (Pacific Missile Range), are presented in tabular form as a function of altitude for monthly and annual periods. The data are tabulated at 1-km intervals from the surface to 27-km altitude and are based upon four observations daily for 5 years of serially completed upper-wind observations made between January 1, 1956, and December 31, 1960. The tabulations are arranged to show cumulative percentage frequencies of occurrence of: scalar winds; zonal and meridional wind components; semiplanar wind components from each of the four cardinal directions; and the vector, zonal, and meridional wind shears for 1000-m altitude layers. Time-altitude cross sections of the zonal and meridional wind components are presented, and a brief discussion of the wind data is given. Author

N63-12058 France. Direction de la Météorologie Nationale, Paris
FLUX DE VENT SUR LE SUD DE LA MER ROUGE AUX NIVEAUX 300, 200, 150 mb [WIND FLUCTUATION SOUTH OF THE RED SEA AT 300, 200, 150 mb LEVELS]
R. Berges Oct. 1962 37 p 4 refs In French
(Monographies de la Météorologie Nationale No. 27)

Frequency charts representing wind fluctuations, between 20° and 10° N, at Djibouti in the area south of the Red Sea are presented. A seasonal variation is evident; the winds blow to the east in summer and to the west in winter. The typical wind fluctuations are examined as a function of the wind force along the north-south path. Further, the latitudinal location of high subtropical pressure centers vary with three periods: November to April, June to September, and the months of May and October exhibiting a transition between the other two periods. Transl. by M.P.G.

N63-12081 Texas A. and M. Research Foundation, College Station
TIME CHANGES IN A TEMPERATE LATITUDE CLOUD AND WEATHER SYSTEM AS REVEALED BY METEOROLOGICAL SATELLITE DATA Scientific Report No. 1
Darryl Randerson Dec. 14, 1962 50 p 19 refs
(Contract AF 19(604)-8450)
(AFCRL-62-867)

The evolution of developing cloud bands accompanying a slowly moving cold front over the central United States was studied using TIROS I photographs as well as conventional analysis tools. These cloud bands appeared to form in the right entrance region of the axis of maximum wind between the 700-mb and 400-mb levels and move east-southeastward. In the vicinity of and just north of the axis of maximum wind was a zone of very dry, cloudless air. Visual evidence is thus available to further support several jet stream models which suggest high clouds in the vicinity of the right entrance region and cloudless skies in the left entrance region of the high level jet stream. A description and explanation of some low cloud phenomena occurring during the period studied are also included. Local effects probably caused the pictured clouds to concentrate along the coast line. Over land, the clouds formed into cloud streets which were oriented parallel to the wind near the cloud base. Author

N63-12085 Stanford Research Inst., Menlo Park, Calif.
A SYMMETRIC REPRESENTATION FOR THREE-BODY PROBLEMS. I. MOTION IN A PLANE
Felix T. Smith Repr. from J. Math. Phys., v. 3, no. 4, July-Aug., 1962 p 735-748 13 refs
(NASA Contract NASr-49-07)

A symmetric representation is sought for the motion of three particles in the limit of weak interaction. Operators with the desired symmetry can be obtained from the 6-dimensional generalized angular momentum tensor [F. T. Smith, Phys. Rev. **120**, 1058 (1960)]. Here, the 4-dimensional problem of motion in a plane is worked out. Symmetric angular coordinates are found, operators and eigenfunctions are constructed, and the coupling coefficients connecting this with more familiar representations are discovered. Formally, the eigenfunctions are similar to the symmetric rotor functions, but with different arguments. Author

N63-12135 Joint Publications Research Service, Washington, D.C.
ON THE RELATIONSHIPS AMONG THE COEFFICIENTS OF TURBULENT MOMENT, HEAT, AND MATTER TRANSFER IN THE SURFACE LAYER OF THE ATMOSPHERE
I. L. Senderikhina Jan. 25, 1963 25 p 40 refs Transl. of article from Trudy Glavnoi Geofiz. Observatorii im. A. I. Voeikova (Leningrad), no. 121, 1961
(JPRS-17299) OTS: $2.60

The present article describes the results of processed data on meteorological elements in the surface layer of the atmosphere and the analysis of hydrodynamic studies of turbulent transfer. It is shown that the ratio of the turbulent moment transfer coefficient to the analogous heat or matter transfer coefficients is always less than one. Author

N63-12167 Agricultural Research Service. Salinity Lab., Riverside, Calif.
WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO SOIL PROPERTIES, PLANT CHARACTERISTICS AND WEATHER Annual Report [1 July 1961 - 30 June 1962]
W. R. Gardner, D. L. Decker, C. F. Ehlig, F. J. Miklich, L. A. Richards, P. L. Richards (Bell Telephone Labs.), and D. I. Hillel (Agricultural Res. Station, Rehovot, Israel) July 1962 85 p refs
(Cross Service Order 2-62)

The research included deals particularly with (a) derivation and laboratory tests of a mathematical treatment of evaporation from bare soil, (b) greenhouse tests of a physical and mathematical model of water uptake and loss by plants, (c) development and tests of methods for measuring the energy status and transmissibility of water in plants and in soils, both in the laboratory and in the field. The following results were obtained: (1) The approximate mathematical treatment for the drying of a bare soil gave good agreement with laboratory experiments. The theory predicts the length of time that a given potential evaporation rate can be maintained and also

predicts the actual evaporation rate when the potential rate can no longer be maintained. (2) The mathematical theory for water uptake by plants has been extended and tested. From the theory, it is possible to calculate water uptake patterns and transpiration rates. Observed results are in good agreement with the theory. (3) A radial flow cell was developed for measuring water transmitting and retaining properties of soil samples at field structure. Preliminary tests indicate that the cell will provide data that will be useful for the application of mathematical theory to soil-water transfer processes in the field. (4) Electrolytic hygrometers are useful over a considerable range of humidity, but for soil and plant measurements at humidities above 99%, available hygrometers of this type have serious limitations. Careful measurements confirm these limitations for the Humistor at high humidity. Author

N63-12289 Michigan U. Meteorological Labs., Ann Arbor

A STUDY OF RAINDROP-SIZE DISTRIBUTIONS AND THEIR VARIATION WITH HEIGHT Scientific Report No. 1

Kenneth R. Hardy Dec. 1962 190 p 102 refs
(Contract AF 19(628)-281)
(AFCRL-62-1091)

Computations of the changes of the raindrop-size distributions with distance fallen are made using an electronic digital computer. Coalescence, accretion and evaporation processes are considered. It is found that an initial exponential distribution having a relatively large negative slope is considerably modified as the rain falls, and a distribution with a relatively small negative slope is only slightly modified by the above three processes. A procedure is presented whereby the raindrop-size distribution at the melting level can be deduced. One study of this type shows that at the melting level (1) more large drops must be present than is indicated by the M-P distribution, and (2) the concentration of the larger drops must not be substantially different from their concentration observed at the ground. Author

N63-12303 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.

WIND VARIABILITY AND ITS EFFECT ON ROCKET IMPACT PREDICTION

Manuel Armendariz, Frank Hansen, and Patsy S. Carnes Jan. 1963 35 p 7 refs
(SELWS-M-21)

Wind variability from 200 to 2000 feet above the surface at White Sands Missile Range was studied. Wind variability as a function of time is presented. Data were obtained from double-theodolite pilot-balloon observations. The absolute mean and the standard deviation of the difference in wind velocity for 100-foot intervals indicate the magnitude of the change that can be expected in a given time increment for a given height level. The effect of this variability on the computed impact point of an Aerobee rocket is discussed. Author

22 NAVIGATION AND GUIDANCE

Includes: autopilots; star tracking; inertial platforms; and traffic control.

For related information see: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities; 15 Instrumentation; 20 Mathematics; and 29 Space Sciences.

N63-11960 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.

PRECISION TIME AND FREQUENCY APPLICATIONS IN THE TRANSIT AND ANNA SATELLITE PROGRAM

L. J. Rueger Dec. 14, 1962 19 p
(Contract NOw 62-0604-c)
(TG-459)

The advent of earth satellites and the advances in frequency and time control in the past decade have opened new fields in global navigation. The Transit program is an application of these achievements. For a navigator to determine his position by the system, Doppler data, orbit data, and accurate time are required. These elements are provided by carrying a precision UT-2 clock and a radio-commanded memory in the polar-orbiting satellite. As a consequence, worldwide time synchronization is an important concept of the program. The ANNA program is a research activity for improving knowledge of the earth geodesy and for comparing several precision orbit-determining techniques. The general features of each system are described, and the time-frequency synchronization problems are discussed. Author

23 PHYSICS, GENERAL

Includes: acoustics; cryogenics; optics; and thermodynamics.

For astrophysics see: 05 Astronomy and Astrophysics.

For related information see: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 24 Physics, Solid-State.

N63-11979 General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.

NUCLEAR SUPERHEAT PROJECT Tenth Quarterly Progress Report, October-December 1961

R. T. Pennington Washington, AEC Div. of Tech. Information July 1962 212 p
(Contract AT(04-3)-189)
(GEAP-4024) OTS: $3.00

This report on the Nuclear Superheat Project covers the following: conceptual design and program evaluation; fuel technology; materials development; experimental physics; coolant chemistry; heat transfer; mechanical development; shade irradiation; and mixed spectrum superheater design study. J.R.C.

N63-11982 Stanford U. Stanford Linear Accelerator Center, Calif.

TRANSVERSE RADIATION SHIELDING FOR THE STANFORD TWO-MILE ACCELERATOR

H. De Staebler, Jr. Nov. 1962 117 p 49 refs
(Contract AT(04-3)-400)
(SLAC-9) OTS: $2.25

Calculations of the shielding required for the Sanford two-mile linear accelerator are presented. These calculations include the determination of radiation tolerances, the estimation of the amount of average electron-beam power that is intercepted by the accelerator, the development of the electromagnetic cascade and the production of penetrating particles from the cascade, the attenuation in the shield, the estimation of the biological hazard of particles passing through the shield, the estimation of the biological hazard as a function of distance from the accelerator, and the estimation of the errors due to approximations in the above calculations. On the basis of these calculations, appropriate thicknesses of earth shielding are recommended for separating the machine from the above-ground klystron gallery, and for the beam switchyard. M.P.G.

N63-11983 Oak Ridge National Lab., Tenn.

NUCLEON-MESON CASCADE CALCULATIONS: THE STAR DENSITY PRODUCED BY A 24-Gev PROTON BEAM IN HEAVY CONCRETE

R. G. Alsmiller, Jr., and J. E. Murphy Jan. 21, 1963
(Contract W-7405-eng-26)
(ORNL-3367) OTS: $0.50

The nuclear star density produced by a 24-Gev proton beam in a material having approximately the properties of heavy concrete has been calculated. A comparison has been made with experimental measurements made at CERN, but, since the quantity which could be calculated is not the same as that which was measured, no firm conclusions can be drawn. Author

N63-11989 Electro-Optical Systems, Inc., Pasadena, Calif.

COHERENT OPTICAL SURVEILLANCE DEVICES [Progress Report No. 3, August 19-November 19, 1962]

Richard E. Bradbury Dec. 1, 1962 33 p 3 refs
(Contract AF 30(602)-2710)
(EOS-2230-Q-3; RADC-TDR-62-606)

A gas-cell phase shifter has been constructed and evaluated in a Twyman-Green interferometer, with both a low pressure mercury lamp (5461 Å) and a Helium-Neon laser (6382 Å) as sources. Measurements of phase shift by fringe displacement correspond well with expected results. Author

N63-12024 Parke Mathematical Labs., Inc., Carlisle, Mass.

MATHEMATICAL DESCRIPTIONS OF POLARIZATION AND RELATED PHENOMENA PART I. CLASSICAL DESCRIPTION Scientific Report No. 11

Frank H. Rowsome III Aug. 1962 26 p refs
(Contract AF 19(604)-7316)
(Rept. 7316-SR-11; AFCRL-62-796)

This paper constitutes a brief review of the mathematical descriptions of polarization which have grown out of experimental optics and classical electromagnetic radiation theory, as well as a review of the classical optical theories relating to polarization phenomena. Emphasis is placed on the interrelation of the formulations. Author

N63-12049 Oklahoma U. Research Inst., Norman

A SEMIEMPIRICAL METHOD FOR THE CALCULATION OF THE SLATER-CONDON PARAMETERS Technical Report No. 5

Chun C. Lin and Neal F. Lane Jan. 1963 10 p 13 refs Repr. from Ann. Phys. v. 20, no. 2, Nov. 1962 p 234-239
(Contract Nonr-982(07))

A semiempirical method for calculating the Slater-Condon parameters for the atoms of the first transition group is presented. This method is based on the use of effective nuclear charges which are determined from the experimental data of ionization potential. The calculated Slater-Condon parameters agree well with the experimental values and show considerable improvement over those obtained from the Slater orbitals (with Slater's screening constants). Applications to the complex ions of the transition elements are discussed. Author

N63-12050 Naples U. (Italy)

HIGH-ENERGY SCATTERING. PART I: ASYMPTOTIC LIMITS IN POTENTIAL SCATTERING AND IN FIELD THEORY. PART 2: ON THE EQUATION FOR THE REGGE TRAJECTORIES

S. Fubini and R. Stroffolini Aug. 1962 49 p 24 refs Lectures on High-Energy Scattering given at the Seminar of Theoret. Phys., Trieste, Aug. 1962
(Sponsored by I. A. E. A.)

Equations are derived for the Regge trajectories in high-energy processes and general methods are discussed for studying these trajectories. A multiperipheral model is used to describe the high-energy processes. These processes are then predicted by combining a series of ladder graphs by means of a linear integral equation for the off-mass shell absorptive amplitude. The high energy collisions are considered as a combination of a large number of low energy interactions. The asymptotic behavior of the amplitude is obtained by considering the high-energy limit of the integral equation. General methods for studying the Regge trajectories in nonrelativistic and potential theory are obtained by transforming the Schroedinger equation. R.C.M.

N63-12054 North Carolina State Coll. School of Physical Sciences and Applied Mathematics, Raleigh

INTRODUCTION TO SLOWING DOWN APPROXIMATIONS IN NEUTRON TRANSPORT THEORY Research Bulletin No. 2

Donald H. Roy and Raymond L. Murray June 1962 88 p 27 refs

The general formulation of the neutron transport equation in the P_L and B_L approximations is examined in detail. The first-order approximations to the general solution, viz., the "ordinary" and "consistent" P_1 and B_1 approximations, are then correlated with the various approximations treating the scattering-in term using the Greuling-Goertzel method as a basis of comparison. These first-order approximations are examined for both isotropic and anisotropic scattering in center-of-mass coordinates. The coupled set of differential equations relating the flux and slowing down density in lethargy space are reproduced for the special case of a bare reactor with sinusoidal fission source. Author

N63-12079 Stanford Research Inst., Menlo Park, Calif.

THREE-BODY COLLISION RATES IN ATOMIC RECOMBINATION REACTIONS

Felix T. Smith Repr. from Discussions of Faraday Soc., no. 33, 1962 p 183-188 10 refs
(NASA Contract NASr-49-07)

A new symmetric representation for 3-body collisions makes it possible to define the 3-body collision rate in terms of the masses and radii of the particles, and the temperature. Comparison with experiment shows that the reaction $I+I+A \rightarrow I_2+A$, with A a rare gas, has a collision efficiency between 1/720 for He and 1/44 for Xe. Author

N63-12094 Watertown Arsenal. Materials Research Lab., Mass.

THE ROLE OF ELECTRON MICROSCOPY IN OBSERVATIONS OF RADIATION DAMAGE

Allen N. Goland Nov. 1962 13 p 5 refs Summary of lecture presented at the Intern. Congress for Electron Microscopy, Philadelphia, Aug. 29-Sept. 5, 1962
(MRL-126)

Radiation-damage theories predict that a variety of defects will be produced in a solid during nuclear bombardment. The spacial extent of some of these defects is within the resolving power of the modern electron microscope. This paper summarizes the theories and their relationship to electron-microscopic observations of radiation-induced defects. Author

N63-12139 General Dynamics Corp. General Atomic Div., San Diego, Calif.

HIGH-ENERGY NEUTRON-INDUCED CHANGES IN CARBON AND GRAPHITE—A REVIEW

Glen B. Engle Sept. 20, 1962 111 p 74 refs
(Contract AT(04-3)-314)
(GA-2802) OTS: $2.25

The pertinent data on the effects of high-energy neutron bombardment on carbon and graphite structure, dimensional stability, properties, and some gas reactions are presented. The basic raw materials and general processes of fabricating nuclear graphite are reviewed, and a series of models are presented for the structure of carbon and graphite. The irradiation data are reviewed with emphasis on correlation of irradiation effects with basic carbon structure. Author

N63-12147 New York U., N. Y.
A MODEL FOR THE STATISTICAL ATOM WITH NON-VANISHING ANGULAR MOMENTUM
Judah L. Schwartz and Sidney Borowitz Dec. 1962 44 p 16 refs (Contracts AF 19(604)-4555, DA 30-069-ORD-2581, and Nonr-285(49))
(Research Rept. CX-59; AFCRL-62-1089)

In the first of the coupled integrodifferential equations satisfied by the Green's functions of the many-body system, the Hartree-Fock approximation is made for the two-particle Green's function. The resulting equation is written in a mixed position-angular momentum representation in such a way that use may be made of whatever empirical information about the angular momentum of the system is available. In contrast to the previous work, the present formalism yields a sign change for the quadrupole coupling constant on passing through closed shells, and calculated values for the quadrupole coupling constant of the halogens are seen to be within an order of magnitude of the accepted values. Author

N63-12154 Minnesota U. Heat Transfer Lab., Minneapolis
SHORTER COMMUNICATION. ABSORPTION OF THERMAL RADIATION IN A V-GROOVE CAVITY
E. M. Sparrow and S. H. Lin Repr. from Intern. J. Heat and Mass Trans., v. 5, 1962 p 1111-1115 2 refs
(NASA Grant NsG-137-61)

This paper describes the energy absorbed when radiation from an external source enters a V-groove cavity. Consideration is given to cavities whose surfaces are either diffuse reflectors or specular reflectors. For each one of these surface conditions, two general types of incoming radiation are studied: (a) energy arriving in a bundle of parallel rays, (b) energy diffusely streaming in through the cavity opening. Author

N63-12161 Columbia U., New York, N.Y.
CYLINDRICAL WAVE IN A VISCOELASTIC SOLID
Jacob Lubliner Nov. 1962 7 p 4 refs Repr. from J. Acoust. Soc. Am., v. 34, no. 11, Nov. 1962 p 1706-1710
(Contract Nonr 266(34); Grant Nonr(G)-0004-61)
(Technical Rept. 14; CU-3-62-ONR-266(34)-CE)

The propagation of a cylindrical wave in an infinite viscoelastic (standard linear) solid is studied by means of the Laplace transformation. Numerical results are obtained over a time interval encompassing the most significant characteristics of wave propagation, namely, attenuation of the initial peak, formation of the delayed peak, and asymptotic decline to the steady state. It is found that no marked change in the wave shape occurs until the distance from the axis exceeds a certain characteristic length (which is infinite in a perfectly elastic solid) and that the change becomes more marked at greater distances. Author

N63-12163 Aerojet-General Corp., Downey, Calif.
AN IMPACT AND PENETRATION EFFECTS STUDY
J. E. Ferguson Eglin AFB, Fla., Air Proving Ground Center, Jan. 1963 154 p 2 refs
(Contract AF 08(635)-975)
(APGC-TDR-63-2)

The shaped-charge hypervelocity projectile-accelerator is being used to study impact and penetration effects upon various thicknesses of targets at velocities between 24,000 and 39,000 feet per second. This report presents and analyzes 208 data points gathered for impacts in the 29,000 to 33,000 feet-per-second velocity range, with 0.03 to 0.8-gram aluminum projectiles against 0.375-inch, 0.500-inch, 1.00-inch and 4.0-inch thick 2024-T4 aluminum target plates; 19 data points gathered for impacts in the 35,000 to 39,000 feet-per-second velocity range with 0.01 to 0.7-gram aluminum projectiles against 0.100-inch thick 2024-T4 aluminum target plates; and 63 data points gathered for impacts in the 22,000 to 26,000 feet-per-second velocity range with 0.02 to 0.7-gram copper projectiles against 0.100-inch thick 2024-T4 aluminum target plates and 0.500-inch thick soft copper target plates. Angles of obliquity between the velocity and the target surface for these experiments were 90°, 50°, and 20°. Curves, photographs, and flash radiographs illustrating the data are presented. Author

N63-12164 Atomic Energy Commission. Div. of Technical Information, Washington, D.C.
METHODS OF ANALYSIS OF NATURAL RADIOELEMENTS
V. L. Shashkin Dec. 1962 148 p 126 refs Transl. by JPRS of "Metody Analiza Estestvennykh Radioaktivnykh Elementov" Moscow State Publishing House of Lit. on Atomic Sci. and Tech., 1961
(AEC-TR-5458) OTS: $2.75

Methods of analysis for determining radioactive elements of the uranium and thorium series are reviewed. These methods include measuring radioactive radiation and determining isotopes of uranium, thorium, protactinium, actinium, radium, and polonium. Emanation methods for determining the isotopes of radium and radon are given special emphasis. B.J.C.

N63-12174 Los Alamos Scientific Labs., N. Mex.
ON THE COMPUTATION OF THE TRANSPORT OF RADIATION
Burton Wendroff Jan. 10, 1963 73 p 12 refs
(Contract W-7405-eng-36)
(LAMS-2795) OTS: $1.75

Some problems associated with the numerical solution of the equations of radiation transport in compressible fluids are discussed. These problems are in the following areas: formulating the differential equations, handling the frequency dependence, obtaining and solving the difference equations. Some specific computing procedures are given. Author

N63-12194 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
IRRADIATION EFFECTS OF 40 AND 440 NEV PROTONS ON TRANSISTORS
William C. Honaker and Floyd R. Bryant Washington, NASA, Jan. 1963 43 p 10 refs
(NASA TN D-1490) OTS: $1.25

Experimental results present data collected before, during, and after the bombardment of several types of transistors with 40 and 440 Mev protons. The degradation of the measured parameters varied with proton energy and with the alpha cutoff frequency of the transistor. Figures are presented which show the degradation of the gain of the transistors as a function of integrated proton flux. Author

N63-12214 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF SPUTTERING WITH HYDROGEN IONS ON TOTAL HEMISPHERICAL EMITTANCE OF SEVERAL METALLIC SURFACES
Donald L. Anderson and George J. Nothwang Washington, NASA, Jan. 1963 37 p 17 refs
(NASA TN D-1646) OTS: $1.00

The test specimens were cylindrical and were constructed from pure titanium, a titanium alloy containing 6-percent aluminum and 4-percent vanadium, pure aluminum, 2024 aluminum alloy, and pure copper. The energy level of the incident ions was 1000 electron volts. The test specimens were subjected to ion bombardment by immersion in a hydrogen plasma. The total hemispherical emittance of each specimen was measured in a cold-wall, vacuum-type calorimeter. Photomicrographs of all test specimens before and after bombardment with 10^{21} ions/cm^2 are presented and discussed. In addition, the changes in weight resulting from ion bombardment of all specimens are presented. Author

N63-12221 Stanford U. Stanford Linear Accelerator Center, Calif.
DESIGN AND FABRICATION OF THE ACCELERATING STRUCTURE FOR THE STANFORD TWO-MILE ACCELERATOR Technical Report
A. L. Eldredge, G. A. Loew, and R. B. Neal Nov. 1962 89 p 18 refs
(Contract AT(04-3)-400)
(SLAC-7) OTS: $2.00

This report describes the principal factors affecting the design and fabrication of the accelerating structure that will be used for the Stanford two-mile linear electron accelerator. The structure will be an all-copper, cylindrical, disk-loaded waveguide, approximately four inches in diameter, and 10,000 feet long. When powered by 240 klystron amplifiers, each operating at a peak power of 24 megawatts, the accelerator will produce a 20-bev electron beam at an average beam current of 30 microamperes (10% beam loading). By increasing the number of klystrons to 960, should this eventually be warranted, the beam energy could be increased to 40 bev, and the average beam current to 60 microamperes. Author

N63-12224 Joint Publications Research Service, Washington, D.C.
SOVIET SCIENTIFIC ACTIVITIES. THIRD ALL-UNION CONFERENCE ON ELEMENTARY PARTICLE THEORY
Yu. M. Lomsadze, V. I. Lend'yel, I. Yu. Krivskiy, and I. V. Khimich Jan. 30, 1963 13 p Transl. of article from Ukr. Fiz. Zh. (Kiev), v. 8, no. 4, Apr. 1962 p 458-454
(JPRS-17376) OTS: $0.75

Abstracts are given of the papers presented at the conference on elementary particle theory. The following are covered: dispersion, strong interactions, weak and electromagnetic interactions, gravitation theory, axiomatic and group-theoretical methods, and new ideas in general quantum field theory. R.C.M.

N63-12233 Translations, New York, N.Y.
MANY-PARTICLE THEORY
A. A. Vlasov Oak Ridge, Tenn., AEC Tech. Inform. Serv. Extension [1962] 415 p refs Transl. of "Theoriya Mnogikh Chastits" Moscow and Leningrad, State Publishing House for Tech. and Theoret. Lit., 1950
(Contract AT(40-1)-2282)
(AEC-TR-3406) OTS: $4.75

A many-particle theory has been developed, based on the properties of many-electron systems and on the theories for near interactions (collisions) and distant interactions of particles. In this theory, motion is an inseparable property of the object and not the result of the action of any "sources," (called forces in classical mechanics, the heat reservoir in statistics, and charges and currents in electrodynamics). Results of the application of this theory to many-electron ensembles, plasma oscillations, crystallization theory, acoustics, and electron interactions in electron-discharge tubes are presented. M.P.G.

N63-12244 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE EFFECT OF VACUUM ON THE PENETRATION CHARACTERISTICS OF PROJECTILES INTO FINE PARTICLES
Leonard V. Clark and John Locke McCarty Washington, NASA, Jan. 1963 27 p 11 refs
(NASA TN D-1519) OTS: $0.75

The penetration characteristics of various spherical projectiles impacting a test-bed material of fine particles were examined in a pressure environment which ranged from atmospheric to 1×10^{-5} mm. Hg. absolute to evaluate the effects of material particle size, variations in the testing technique, and several of the projectile variables. The results of this study indicate that the depth of penetration in a granular material is independent of environmental pressure and the particle size, whereas the penetration depth in a powdery material increases with decreasing particle size and is independent of the environmental pressure only for pressures less than 1 mm. Hg. Author

N63-12282 California U., Berkeley. Inst. of Engineering Research
ON A NONLINEAR THEORY OF ELASTIC SHELLS
W. L. Wainwright Jan. 1963 34 p 6 refs
(Contract Nonr-222(69))
(IER Ser. 131, Issue 18)

This paper is concerned with a nonlinear theory of elastic shells with small deformations whose material response is nonlinear. The developments are carried out under the Love-Kirchhoff hypothesis. General constitutive equations are derived in which the geometrical properties (due to deformation) and the material characteristics are separable. Through this separability, it is shown how to extract constitutive equations of predetermined types. Particular examples are followed by a discussion of the membrane theory. Author

N63-12310 Florida State U. Tandem Accelerator Lab., Tallahasee
TANDEM ACCELERATOR PROGRAM Annual Progress Report for Year 1961
G. M. Temmer [1962] 112 p 17 refs
(Contract AF 49(638)-427)

The experimental program, theoretical studies, and instrumentation for the Tandem Accelerator Program are discussed. The following progress has been achieved: (1) The helium beam has been brought up to 19.6 Mev. (2) He^3 has been accelerated and yields currents comparable to those obtained with ordinary helium. This provides a useful and unique means for investigation of nuclear structure and reaction mechanisms. (3) A gamma cave has been completed, and refrigerated cold traps have been installed on the main machine vacuum system. D.B.

N63-12326 Joint Publications Research Service, Washington, D. C.
THE ZEEMAN PHENOMENON AND MAGNETIC RESONANCE
M. A. Yel'yashevich Jan. 31, 1963 81 p 34 refs Transl. of Chap. 14 from the book "Atomnaya i molekulyarnaya spektroskopiya" Moscow, State Publishing House for Physico-Mathematical Literature, 1962 p 367-408
(JPRS-17398) OTS: $2.00

An extended discussion on the magnetic cleavage of spectral lines and energy levels in a magnetic field is given. Formulas are applied to Zeeman's phenomenon to derive, in a linear mode, explanations for the events that occur when degenerated levels of atom energy in a magnetic field are separated into nondegenerate sublevels. A.R.B.

N63-12338 Brookhaven National Laboratory, Upton, N. Y.
NEUTRON CROSS SECTION EVALUATION GROUP. NEWSLETTER NO. 7 [BIBLIOGRAPHY OF RUSSIAN SOURCES]
Sophie Moore Oct. 1962 17 p
(BNL 768(N-7)) OTS: $0.50

This bibliography is a presentation of Russian abstracts in the fields of neutron cross sections and related neutron constants. I.v.L.

24 PHYSICS, PLASMA

Includes: fusion; and magnetohydrodynamics.

For related information see: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N63-11973 Aro, Inc., Arnold Air Force Station, Tenn.

THE RADIATIVE DECAY OF METASTABLE ARGON ATOMS IN A LOW-DENSITY ARGON PLASMA STREAM

L. E. Brewer and W. K. McGregor Arnold Engineering Development Center, Jan. 1963 25 p 16 refs
(Contract AF 40(600)-1000)
(AEDC-TDR-63-5)

A low-density, luminous, supersonic, argon plasma stream about one meter in length, produced by a conventional d.c. arc plasma generator, was studied spectroscopically. The spectra consisted of neutral argon atom lines and second positive nitrogen bands. Stream enthalpy and velocity calculations rule out thermal excitation and electron-ion recombination as sources of the radiation. Radiative decay of metastable argon atoms will, however, account for the long lifetimes of the radiating argon and also for the excitation of the nitrogen, which enters the stream by mixing with the ambient test-cell gas. The existence of metastable atoms and their behavior are further examined by use of additive gases. Atoms with excitation levels below the potential of the argon metastables (hydrogen and krypton) tend to quench the radiation, whereas those with higher excitation levels (helium and neon) have no effect on the argon metastables, and their presence is not spectroscopically detectable. The existence of metastable atoms and the fact that the stream luminosity is caused by their radiative decay are important in diagnostic techniques and render conventional spectroscopic and probe procedures of little use. The discovery of the metastables within the gas stream, however, provides an avenue to studies of collision processes that have heretofore been limited to short-lived afterglows using fast-response instrumentation. Author

N63-12033 Cornell U. Center of Radiophysics and Space Research, Ithaca, N.Y.

MAGNETOSPHERIC INTERCHANGE INSTABILITY FOR AN IDEAL PLASMA

B. U. Ö. Sonnerup and M. J. Laird Oct. 1962 60 p 10 refs
(NASA Contract NsG-184-60)
(CRSR-130) OTS: $5.60 ph, $2.00 mf

Gold has pointed out that the gas in the magnetosphere of the earth can take part in large-scale motions in which tubes of force of equal flux and the gas within them are interchanged. Such motions leave the magnetic field and its energy almost unchanged, and may therefore be driven by variations in the state of the gas. In this report the stability of the magnetosphere against such motions occurring spontaneously is studied by investigation of the change in potential energy of the system during a hypothetical interchange of two tubes of force. Author

N63-12035 United Aircraft Corp. Research Labs., East Hartford, Conn.

RESEARCH ON THE COLLISION PROBABILITIES OF ELECTRONS AND CESIUM IONS IN CESIUM VAPOR Quarterly Status Report No. 1, May 1-July 31, 1962

R. H. Bullis and R. K. Flavin July 31, 1962 48 p 5 refs
(NASA Contract NASr-112)
(A-920057-1) OTS: $4.60 ph, $1.64 mf

This report describes work on a research program to determine the collision cross sections of ions and electrons in cesium vapor. The cross-section measurements are necessary for the formulation of quantitative analyses of the operation of thermionic converters or other devices using cesium vapor. The electron cyclotron resonance technique is being employed to determine the electron collision cross section, and a modification of the Ramsauer experiment designed to eliminate contact potentials is being employed to measure the ion collision cross sections. To check the accuracy and repeatability of the electron collision cross-section measurement, a new quartz tube containing a fresh charge of cesium was employed in the experiment and more extensive measurements taken. The agreement between the two measurements was within the experimental error. Also, satisfactory progress was made in the design and construction of the apparatus for the measurement of ion collision cross sections. Author

N63-12042 Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park

NONLINEAR LANDAU DAMPING OF OSCILLATIONS IN A BOUNDED PLASMA

David Montgomery Oct. 1962 19 p 15 refs
(NASA Contract NsG-220-62)
(BN-301) OTS: $1.60 ph, $0.80 mf

A previously developed perturbation-theory-to-all-orders formalism is applied to the oscillations of a "collisionless" electron plasma which is bounded by perfectly reflecting walls. The $t \to \infty$ damping rate is the same for the n^{th} order as for the first order. This result generally does not apply to the unbounded plasma. Author

N63-12089 General Electric Co. Space Sciences Lab., Philadelphia, Pa.

EXACT SOLUTIONS FOR MAGNETOHYDRODYNAMIC CHANNEL FLOWS

A. Sherman Dec. 1962 70 p 19 refs
(Contract AF 49(638)-914)
(R62SD991 - Class I)

The present report concerns itself with those simplified MHD Channel Flow problems for which exact solutions can be found. Both steady state and transient problems are considered, and account is taken of heat flux as well as velocity distributions. Secondary flows are also discussed. The bulk of the solutions are valid for arbitrary Magnetic Reynolds numbers, although some channel flows with nonuniform magnetic fields and small Magnetic Reynolds numbers are discussed. Author

N63-12107 General Dynamics/Astronautics. Space Science Labs., San Diego, Calif.

METHODS OF ANALYSIS OF MICROWAVE SCATTERING FROM WAKES OF HYPERVELOCITY PROJECTILES

W. R. Bradford and B. H. Siperly Feb. 12, 1962 34 p 5 refs
(Contracts DA-04-495-ORD-3112 and DA-04-495-ORD-3383; Proj. Defender)
(AE-62-0218 M)

Interpretation of ballistic range experimental results is outlined for tests conducted with 20-mm blunt polyethylene projectiles. A detailed theoretical treatment of forward-scattered microwave signals from a dilute plasma column is given. Estimates of ionized wake diameters are made from schlieren photographs of the flow field and are related to back-scattered microwave signals. Returns from perfect scattering rods are compared to returns from an ionized wake in the overdense case. Decay rate changes are noted on microwave returns from an ionized wake and may indicate the transition from laminar to turbulent flow. An indication of "roughness" and separation of scattering centers is shown. General plans for future tests are given. Author

N63-12124 General Electric Co. Space Sciences Lab., Philadelphia, Pa.

MACROSCOPIC EQUATIONS GOVERNING THE INTERACTION OF ELECTROMAGNETIC WAVES WITH NON-UNIFORM PLASMA FLOWS

K. T. Yen Sept. 1962 21 p 9 refs
(Contract AF 30(602)-1968)
(R62SD14)

A method of analysis for the interaction between electromagnetic waves and a nonuniform plasma flow is presented. The electromagnetic waves are taken to be in the microwave range. By using a fully ionized gas as a model, two coupled sets of macroscopic equations are obtained: the flow equations and the field equations. Special consideration is given to the case where diffusion and charge separation can be disregarded. It is shown that both sets of equations can be reduced to useful forms. Physical significance of these equations and extension of this method to include charge separation and partially ionized plasmas are briefly discussed. Author

N63-12145 AeroChem Research Labs., Inc., Princeton, N.J.
MAGNETOHYDRODYNAMIC EFFECTS ON STAGNATION-POINT HEAT TRANSFER FROM PARTIALLY IONIZED NONEQUILIBRIUM GASES IN SUPERSONIC FLOW
J. B. Wilkinson Mar. 1962 36 p 25 refs For Presentation at the Third Symposium on the Engineering Aspects of Magnetohydrodynamics, University of Rochester, N.Y., Mar. 28-29, 1962
(Contract AF 33(616)-6717)
(AeroChem-TP-43)

The effects of dipole-like magnetic fields on stagnation-point heat transfer to a blunt, axisymmetric body in supersonic, nonequilibrium plasma streams have been studied experimentally. Methods of characterizing the gaseous stream, both aerodynamically and electrically, are described. To determine the extent to which the classical continuum magnetohydrodynamic model can predict energy transfer rates in ionized gas streams, heat flux data is reported as a function of the conventional MHD interaction parameter. This parameter is shown to yield inadequate correlation in the regimes covered, suggesting that important extensions of the MHD model are still needed before reliable predictions of energy transfer rates from ionized gases at low densities in regions of high magnetic field strengths can be made. Author

N63-12258 Oak Ridge National Lab., Tenn.
DCX-2 PERFORMANCE CURVES
M. Rankin and T. K. Fowler Jan. 28, 1963 20 p 3 refs
(Contract W-7405-eng-26)
(ORNL-3387) OTS: $0.50

This report gives performance curves of steady state ion density versus injected currents for a survey of various parameters. The parameters are E_M, the energy of injected H_2^+ ions; L, the ion path length; and factors h and Γ, where h/Γ is the fraction of the undissociated portion of the molecular beam not absorbed and Γ is taken as 2. Performance curves are also computed assuming the energy transfer rates to be enhanced by arbitrary factors of 10 and 100. Author

25 PHYSICS, SOLID-STATE

Includes: semiconductor theory; and masers.

For related information see: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N63-11967 Alfred U. New York State Coll. of Ceramics
SEMICONDUCTING MATERIALS Annual Summary Report, 30 November 1961-1 December 1962
Thomas J. Gray Jan. 4, 1963 38 p 28 refs
(Contract Nonr-1503(01))

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2. SECTION II SEMICONDUCTING PROPERTIES OF BORON PHOSPHIDE G. I. Post p 5-14 (See N63-11969 05-25)
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N63-11968 Alfred U. New York State Coll. of Ceramics
SECTION I. THERMOELECTRIC PHENOMENA
Lyle Slack *In its* Semiconducting Materials Jan. 4, 1963 p 1-4 (See N63-11967 05-25)

The apparatus for measuring thermal conductivity of semiconductors by the series comparative method has been redesigned. It is a basic assumption of the series comparative method that heat energy flows through the standard sample-standard stack as a truly parallel flux without radial heat loss or gain. The modifications are to increase the assurance of low radial heat loss. R.C.M.

N63-11969 Alfred U. New York State Coll. of Ceramics
SECTION II. SEMICONDUCTING PROPERTIES OF BORON PHOSPHIDE
G. I. Post *In its* Semiconducting Materials Jan. 4, 1963 p 5-14 (See N63-11967 05-25)

Hot pressed products of boron phosphide (BP) have been prepared under a variety of conditions and subjected to chemical and crystallographic studies. The chemical and structural variations found in these studies will be related to the electrical properties of BP. R.C.M.

N63-11970 Alfred U. New York State Coll. of Ceramics
SECTION III. PHOTOCONDUCTIVITY
G. T. Lewis *In its* Semiconducting Materials Jan. 4, 1963 p 15-18 (See N63-11967 05-25)

The apparatus for photoconductivity measurements has been modified to extend the scope of the measurements and increase their accuracy. Studies were made of ZnTe and ZnO with this apparatus. The absorption edge of single ZnTe crystals at liquid nitrogen temperature was measured as 0.56 μ (2.2ev). The measurements made on a vapor deposited ZnO film indicated an excess of Zn, and additional oxidation was required to approach the stoichiometric value. R.C.M.

N63-11971 Alfred U. New York State Coll. of Ceramics
SECTION IV. INFRARED TRANSMITTING MATERIALS
Donald Guile *In its* Semiconducting Materials Jan. 4, 1963 p 19-34 (See N63-11967 05-25)

Techniques and apparatus have been developed for measuring the dielectric and mechanical properties of infrared transmitting materials. The capacitance, dielectric constant, and the dissipation or loss factor of materials such as the selenides and tellurides of zinc and cadmium, can be measured over a frequency range of from 1000 to 100 kc and a temperature range of from ambient to 1000° C. The mechanical properties such as Young's modulus and internal friction can be determined. Apparatus is available for measuring the thermal conductivity by either the steady-state method or the nonsteady-state method. R.C.M.

N63-11998 California U., Berkeley. Lawrence Radiation Lab.
MECHANISMS OF GASEOUS PERMEATION THROUGH GLASS, SINGLE-CRYSTAL SILICON, AND GERMANIUM; AND STRESS-ENHANCED GASEOUS PERMEATION THROUGH ALUMINA BODIES
Perry Louis Studt Sept. 26, 1962 141 p 65 refs
(Contract W-7405-eng-48)
(UCRL-10466) OTS: $2.50

A development of a more fundamental and quantitative understanding of the transport of noble gas atoms through glasses and single-crystal Si and Ge is presented. Literature pertinent to gaseous permeation through these materials is reviewed with respect to experimental data and explanations for the observed permeations. A series of equations for the permeation coefficient is developed in terms of the solubility coefficient and diffusion coefficient. The theory is further extended for Si and Ge to include calculation of the activation energy for diffusion and solution. From this resulting quantitative

theory, it is possible to explain the relationship of glass modifiers to permeability, and the increase in density with increasing amounts of glass modifiers up to about 10 mol percent, and to identify the forces probably responsible for the observed activation energies for diffusion and solution. An investigation is made of the effect of induced stresses on permeation through normally impermeable high-purity Al_2O_3 bodies. Stress-enhanced permeation is found and related to the microstructure of these bodies. Adsorption of helium on internal surfaces of these bodies is also found, as well as initial stress-free permeability for specimens that later become impermeable. The permeability found is considered to be significantly different from that discussed for glass and single-crystal silicon and germanium. Author

N63-12181 Interchemical Corp. Central Research Labs., New York, N.Y.
POLYMERS AS CONDUCTORS AND SEMICONDUCTORS
Herman F. Mark (Polytechnic Inst. of Brooklyn. Polymer Research Inst.) and Michael Backer [1962] 29 p 19 refs

The conductive and semiconductive properties of organic polymers are discussed and methods for preparing semiconductive polymers are reviewed. The methods for introducing conductance to a polymer include: mobile ions; mobile electrons; metallo-cyclics; and hetero-atoms. R.C.M.

N63-12223 Joint Publications Research Service, Washington, D.C.
RECOMBINATION OF DISLOCATIONS IN GERMANIUM
L. I. Kolesnik Jan. 29, 1963 11 p 11 refs Transl. from Fiz. Tverd. Tela (Leningrad), v. 4, no. 6, June 1962 p 1449-1454
(JPRS-17348) OTS: $0.50

This study examines recombination of linear dislocations, introduced by means of plastic deformation, in germanium of electron and vacancy conductivity in a temperature interval of 300° to 110° K. In the temperature interval study, the lifetime of both types of conductivity as a function of the temperature in the samples can be represented in the form of an exponent with the energy of activation ~ 0.22 ev (300° to 200° K) and by step function $T\alpha$, where $\alpha = 4\text{-}4.5$. It is shown that in germanium of electron conductivity the lifetime as a function of the temperature in the interval 300° to 110° K is determined by the coefficient of vacancy capture at a dislocation as a function of temperature. The radius of vacancy capture at a dislocation proved to be equal, at 300° K, 2×10^{-8} cm, and to 6×10^{-6} cm at 130° K. Author

N63-12234 Oklahoma U. Research Inst., Norman
MAGNETIC SUSCEPTIBILITIES OF VANADIUM-DOPED CORUNDUM CRYSTALS Technical Report No. 4
C. Richard Quade, William H. Brumage, and Chun C. Lin Jan. 1963 3 p 6 refs Repr. from J. Chem. Phys., v. 37, no. 6, Sept. 15, 1962 p 1368-1369
(Contract Nonr-982(07))

The magnetic susceptibilities of vanadium-doped corundum crystals were measured with a Faraday-type balance and the structural parameters $g_\perp$, ΔT, and λ were determined. The measurements were taken parallel to ($\chi_\parallel$) and perpendicular ($\chi_\perp$) to the trigonal axis of the crystal over the temperature range of 77° to 285° K. The difference in intercept of the straight lines for $\chi_\parallel$ and $\chi_\perp$ extrapolated to $T = \infty$ gives $\Delta T = 1200 \pm 200$ cm^{-1}. This result is consistent with McClure's value of 960 cm^{-1} but differs from the result of Zverev and Prokhorov (280 cm^{-1}). R.C.M.

N63-12314 Pennsylvania U. Lab. for Research on the Structure of Matter, Philadelphia
GREEN FUNCTION THEORY OF FERROMAGNETISM Technical Report No. 4
Herbert B. Callen Nov. 1962 34 p 11 refs
(Contract Nonr 551(36))

A theory of ferromagnetism for general spin, approximately valid through the entire temperature range, is given. At low temperatures the magnetization agrees with the Dyson results, having no term in T^3 and having a term in T^4 equal to that found by Dyson in first Born approximation; terms arising from the approximations of the theory first appear in order $T^{3(2S+1)/2}$, so that a spurious T^3 term does appear for $S = \frac{1}{2}$, but for no other spin. Curie temperatures are within a few percent of the Brown and Luttinger estimates for spins greater than unity, and agree within one percent of the Domb and Sykes estimate of the large spin limit. The susceptibility at high temperatures agrees with the Opechowski expansion to terms in $1/T^2$. The quasiparticle energies are renormalized by the energy at low temperature and by the magnetization at higher temperature. The Green function is decoupled by a physical criterion involving self-consistency of the decoupling at all temperatures. The Green function method is extended to higher spin by a technique of parametrizing the Green function and explicitly finding the functional dependence on this parameter by solution of an auxiliary differential equation. Author

26 PROPELLANTS AND COMBUSTION

Includes: fuels; igniters; and oxidizers.

For related information see: 07 Chemistry; and 27 Propulsion.

N63-11972 Bureau of Mines, Washington, D.C.
STRUCTURE AND PROPAGATION OF TURBULENT BUNSEN FLAMES
David Burgess Washington, GPO, 1962 47 p 31 refs
(*Its* Bull. 604) GPO: $0.30

The present report deals exclusively with a second stage of work concerned with turbulent flames, that was carried out between November 1954 and August 1959. Six publications have set forth most of the significant results. This summary report includes a few new data, but its chief purpose is to reorient the findings toward a better appreciation of what has been accomplished and what most profitably might be done in the near future. Author

N63-12097 General Applied Sciences Labs., Inc., Westbury, N.Y.
EXPERIMENTAL RESULTS ON SUPERSONIC COMBUSTION Technical Report No. 322
J. Tamagno and O. Lindermann Dec. 1962 35 p 8 refs
(Contract AF 49(638)-991)

An experiment which permitted the study of supersonic combustion of air and hydrogen in a short time duration facility (shock-tunnel) is described. A model, which was located in the center of a conical nozzle, was designed and fabricated for these tests. A series of tests were performed at approximately 11,000 ft./sec. for a large range of burner static pressures and static temperatures. The results of these tests were compared with a theory developed for premixed reactants. From this comparison the following conclusions were drawn: (1) If the initial static temperature and the static pressure of the airstream are high enough, diffusion will be rate-controlling, and a mixing theory using equilibrium chemistry can be used in analyzing the combustion process. (2) If the chemical reactions are slow, the combustion process behavior can be studied as a system where mixing and diffusive effects are absent. (3) The ignition delay times inferred from the initiation of the pressure rise along the burner are in good agreement with those predicted by the empirical correlation. (4) The

static temperature exerts a greater influence on the ignition delay time than the static pressure. (5) The static pressure level is an important parameter in determining the time for complete combustion. A.S.

N63-12110 Stanford Research Inst., Menlo Park, Calif.
SOLID PROPELLANT MECHANICAL PROPERTIES INVESTIGATIONS Quarterly Progress Report No. II, September 1 to November 30, 1962
Norman Fishman and James A. Rinde Dec. 13, 1962 29 p
(Contract AF 04(611)-8388)
(Rept. 6)

Carboxy-terminated polybutadiene and polyurethane compositions for use in this program have been prepared; sufficient quantities of bagged and unbagged end-bonded specimens are in desiccated storage. Instron quality-control test data for all batches of the polyurethane composition are tabulated; although these data do not provide good evidence for batch-to-batch reproducibility, volumetric swelling ratios show little difference among batches of each composition. The dilatometer has been completed and is undergoing final evaluation and calibration. Preliminary measurements of volume change during extension at constant strain rate demonstrate adequate sensitivity and effective operation. Tests of desiccated end-bonded specimens at several constant strain rates and temperatures using the Instron have been completed; ultimate property data on carboxy-terminated polybutadiene composition AFBA-1 are not particularly consistent and do not yield a well-defined failure envelope, except in the case of batch NF2/238. Constant load and constant loading rate tests of the carboxy-terminated polybutadiene composition are being made, and some preliminary data are presented. Author

N63-12114 Naval Ordnance Lab., White Oak, Md.
ENERGY REQUIREMENTS FOR THE INITIATION OF WIRE AND CARBON BRIDGE PRIMERS CONNECTED ELECTRICALLY IN PARALLEL OR SERIES
E. Eugene Kilmer Feb. 1962 25 p 4 refs
(NOLTR-61-171)

In order to gain information about explosive train reliability, carbon bridge and wire bridge primer ignition assemblies were tested in parallel and in series by capacitor discharge. In addition, wire bridge assemblies were tested in parallel and in series by constant current. About twice as much energy was required to fire two carbon bridge assemblies as to fire a single one. It required 2.6 times as much energy by capacitor discharge to fire two wire bridge assemblies as to fire one. Under constant current conditions, two wire bridge ignition assemblies in series required the same current as a single unit but for two in parallel more than twice the current was needed than for a single unit. Author

N63-12123 Rocketdyne, Canoga Park, Calif.
RESEARCH IN HYBRID COMBUSTION Quarterly Report for Period Ending 31 August 1962
M. V. Peck, T. Houser, and H. N. Chu Jan. 16, 1963 32 p 8 refs
(Contract Nonr-3016(00))
(R-2267-8)

The radius vs. time data taken at two oxygen flow rates were fitted by the empirical equation $r = A + Bt^c$. The instantaneous burning rate, $\dot{r}$, is obtained by differentiation of this equation. The thermocouple measurements were described by the pseudo-steady-state heat conduction equation $T = T_S \exp(-bx/k)$. Author

N63-12157 Monsanto Research Corp., Dayton, Ohio
SURVEY OF RECENT RESEARCH ON FLAME EXTINGUISHMENT [Annual Progress Report, May 1961 to Sept. 1962]
G. B. Skinner Wright-Patterson AFB, Ohio Directorate of Aeromechanics, Dec. 1962 26 p 87 refs
(Contract AF 33(657)-7617)
(ASD-TR-408, Suppl. 1)

Current state of the art in flame extinguishment by chemical and physical agents is reviewed, based on papers published during the period April 1961 to August 1962, in technical journals, trade literature, and Government reports. Papers presented in two symposia are also considered. Author

N63-12160 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
EFFECT OF SURFACE ENERGY ON THE LIQUID-VAPOR INTERFACE CONFIGURATION DURING WEIGHTLESSNESS
Donald A. Petrash, Thomas M. Nelson, and Edward W. Otto Washington, NASA, Jan. 1963 33 p 4 refs
(NASA TN D-1582) OTS: $1.00

An investigation using capillary phenomena verified the contention that the liquid-vapor interface tends to assume a configuration corresponding to a condition in which the surface energies of the system are at a minimum and indicated that the phenomena can significantly alter the liquid-vapor interface depending on the geometry employed. The effect of using a capillary tube to alter the interface configuration in a spherical and a cylindrical tank was such that the liquid was positioned in the lower portion of the tank with the vapor located at the top of the tank. Author

N63-12170 Monsanto Research Corp., Dayton, Ohio
MECHANISM AND CHEMICAL INHIBITION OF THE HYDRAZINE-NITROGEN TETROXIDE REACTION [Final Report, Aug. 1961-Oct. 1962]
G. B. Skinner, W. H. Hedley, and A. D. Snyder Wright-Patterson AFB, Ohio, Flight Accessories Lab., Dec. 1962 35 p 21 refs
(Contracts AF 33(616)-7757 and AF 33(657)-7617)
(ASD-TDR-62-1041)

The mechanism of the hydrazine-nitrogen tetroxide reaction was investigated by examination of the variation in reaction products and equilibrium reaction temperature with increasing reactant concentration when argon-diluted reactant streams were rapidly mixed in a flow reactor. It is concluded that the reaction proceeds through a thermal reaction mechanism rather than a chain-branched explosion mechanism. An ignition test was devised to determine the effect of candidate reaction inhibitors. No effective inhibitors were found among 27 gaseous and 28 liquid additives tested. Thiophene, toluene, trimethyl borate, ethyl bromide, and benzene produced some inhibition, but only at high concentrations. These results support the conclusions that a thermal mechanism is operative. Author

N63-12171 Monsanto Research Corp., Dayton, Ohio
CHEMICAL INHIBITION OF THE HYDROGEN-OXYGEN REACTION [Final Report, 1 Dec. 1960-30 Nov. 1962]
G. B. Skinner, D. R. Miller, J. E. Katon, W. H. Hedley, G. H. Ringrose, and A. D. Snyder Wright-Patterson AFB, Ohio, Flight Accessories Lab., Dec. 1962 117 p 39 refs
(Contracts AF 33(616)-7757 and AF 33(657)-7617)
(ASD-TDR-62-1042)

The effects of inhibitors on the hydrogen-air reaction were studied by measuring flame speeds of hydrogen-air-inhibitor mixtures, and via shock tube and spectroscopic techniques. The best inhibitors were hydrocarbons as a group, bromine-substituted hydrocarbons, several metallic chlorides, and iron carbonyl. Detailed kinetic studies of the effects of CH_4, C_2H_4, C_2F_3Br, and $C_2F_4Br_2$ on the hydrogen-oxygen reaction indicate that they remove radicals, chiefly H atoms, from the reacting gas when it is in the temperature range 900° to 1300° K. Methods for calculating reaction kinetics from the experimental data are described. Author

N63-12178 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
RECOMBINATION AND CONDENSATION PROCESSES IN HIGH AREA RATIO NOZZLES

Walter T. Olson Repr. from ARS Journal, May 1962, p 672-680 33 refs Presented at the ARS Space Flight Report to the Nation, N.Y., Oct. 9-15, 1961 Previously processed as a preprint; see N62-13628 10-27

Recombination and condensation processes in high area ratio nozzles are studied. Because of the inherent complexity of the mechanisms involved, there are very few systems for which recombination or condensation can accurately be predicted by calculations with fundamental rate equations and data. Estimates from rate data indicate that jet fuel air engines should perform near frozen values and that hydrogen nuclear rockets should perform at intermediate values. Direct observations of nozzle performance indicate near-equilibrium performance for hydrogen-oxygen rockets and for hydrogen-fluorine rockets (except near stoichiometric), intermediate performance for jet fuel-oxygen, and intermediate performance for hydrogen-air. Nozzle design appears to be a significant factor for the performance of hydrogen-fluorine rockets. Metallized propellants suffer some performance loss because of the velocity lag in particles that are larger than 10^{-4}cm. J.R.C.

N63-12199 Naval Ordnance Lab., White Oak, Md.

EXPLOSIONS IN VACUUM

Morton Lutzky Nov. 1962 28 p 8 refs

(NOLTR-62-19)

The results of an IBM-704 machine calculation of the explosion of a 1-lb. charge of pentolite in vacuum and the expansion of the detonation product gases to strike a concentric rigid spherical target are reported. Alternative equations of state were employed in the calculation (ideal gas with constant gamma, and ideal gas with variable gamma) and the results compared. Plots are given of pressure and energy density, versus distance, at various times after the wall has been struck, and the pressure-time histories of the gas at the wall. Author

N63-12207 Aeronutronic, Newport Beach, Calif.

INVESTIGATION OF THERMODYNAMIC PROPERTIES OF ROCKET COMBUSTION PRODUCTS First Quarterly Technical Report, 1 Oct.-31 Dec. 1962

D. L. Hildenbrand, L. P. Theard, and F. Ju Jan. 31, 1963 18 p 14 refs

(Contract AF 04(611)-8523; ARPA Order 348-62)

(Publication U-1988)

Results of mass spectral studies of the vapor above beryllium fluoride indicate that the vapor is composed predominantly of monomeric BeF_2 molecules with only a trace of polymeric species present in the range 700° to 1000° K. A mass spectrometric examination of the equilibrium vapor above a mixture of beryllium fluoride and elemental aluminum revealed the presence of BeF_2 (g), AlF (g), and AlF_3 (g). From the temperature variation of appropriate ion intensities in the range 840° to 919° K the heats of formation of BeF_2 (g) and AlF (g) at 298° K were derived as –176.7 kcal/mole and –60.9 kcal/mole, respectively. The equilibrium pressure of AlF (g) over the BeF_2-Al mixture has been measured by the torsion method. Measurements of the vapor pressure of $BeCl_2$ have been made in the range 460° to 500° K by the torsion-effusion method, using two different quartz cells. Author

N63-12263 Academy of Sciences (USSR). G. M. Krzhizhanovsky Inst. of Power Engineering, Moscow

HYDRODYNAMIC INHOMOGENEITIES IN THE THEORY OF COMBUSTION AND EXPLOSION

A. S. Predvoditelev *In* Israel Program for Scientific Translations, Ltd., Jerusalem Gas Dynamics and Physics of Combustion 1962 p 1-39 (See N63-12262 05-11) OTS: $1.75

A general theory is developed for describing discontinuous processes and some applications to hydrodynamic inhomogeneities are discussed. Starting with a geometrical model of an *n*-dimensional space with a hypersurface, Hadamard's method of operator differences is used to express the discontinuities in the coordinates of the system. Algebraic operations are developed which transform the operator difference method into a tool that does not require special analysis for a particular calculation. Applications of this method are discussed as follows: normal combustion wave and shock discontinuity as hydrodynamic inhomogeneities; motion of a combustion zone; motion of a shock discontinuity in a medium capable of chemical reaction; stability of motion of the shock discontinuity. R.C.M.

N63-12264 Academy of Sciences (USSR). G. M. Krzhizhanovsky Inst. of Power Engineering, Moscow

PROPAGATION OF SHOCK WAVES IN THE COMBUSTION PRODUCTS OF HYDROGEN-OXYGEN MIXTURES

T. V. Bazhenova and L. P. Kayashin *In* Israel Program for Scientific Translations, Ltd., Jerusalem Gas Dynamics and Physics of Combustion 1962 p 40-45 12 refs (See N63-12262 05-11) OTS: $1.75

The combustion processes of hydrogen-oxygen mixtures were studied to determine the variation of the shock-wave velocity with time as a function of the different parameters of the explosive mixture. Mixtures ranging from 33% to 75% were detonated and the shock wave propagation was recorded by Schlieren photography. The variation of the shock wave velocity with time was determined from the photographs and the damping coefficients determined on the basis of the velocity of sound for the combustion products. The k_1 coefficient decreased with an increase in H_2 content and the k_2 coefficient had a minimum corresponding to an equal O_2- and H_2-content. An analysis of this data on the basis of chemical kinetics for the O-H reaction indicates that complete combustion of the gases has not occurred within the combustion wave, and that the process of burning continues for about 10^{-3} sec. R.C.M.

N63-12265 Academy of Sciences (USSR). G. M. Krzhizhanovsky Inst. of Power Engineering, Moscow

PROPAGATION OF WAVES OF FINITE AMPLITUDE GENERATED DURING THE EXPLOSION OF A GAS IN A CYLINDRICAL VESSEL OF VARIABLE VOLUME

T. V. Bazhenova *In* Israel Program for Scientific Translations, Ltd., Jerusalem Gas Dynamics and Physics of Combustion 1962 p 46-52 (See N63-12262 05-11) OTS: $1.75

Time analyses of the explosion of hydrogen-oxygen mixtures in vessels of variable volume were obtained by photography to study the combustion processes. Mixtures ranging from 33% to 75% hydrogen were ignited in a plexiglas tube fitted with a piston. The mass of the piston was varied between 10 g and 60 g. An analysis of the photographs obtained show that the presence of gas expansion has no influence on the nature of the chemical reaction taking place with the frontal zone of the shock wave. Gas expansion does contribute to a quicker damping of the shock-wave velocity than in the constant volume vessel. Another factor in damping is the hydrodynamic cooling by gas expansion. R.C.M.

N63-12266 Academy of Sciences (USSR). G. M. Krzhizhanovsky Inst. of Power Engineering, Moscow

THE INFLUENCE OF EXTERNAL FRICTION AND HEAT EXCHANGE ON THE MOTION OF AN IGNITION SURFACE AND A SHOCK-DISCONTINUITY IN A CHEMICALLY REACTIVE MEDIUM

L. P. Kayushin *In* Israel Program for Scientific Translations, Ltd., Jerusalem Gas Dynamics and Physics of Combustion 1962 p 53-65 2 refs (See N63-12262 05-11) OTS: $1.75

Combustion studies were made to study the effect upon flame-propagation velocity of grids and constrictions and the effect of heat exchange on the formation of acoustic-shock discontinuities. Different mixtures of hydrogen-oxygen were detonated in a rectangular chamber (2.3 × 2.6 × 17.5 cm), and the flame propagation was recorded by the Schlieren method. The presence of a grid was found

to increase the combustion-wave velocity linearly as a function of the ratio of the number of grid elements to the radius of the grid elements. With a diaphragm in the wave path, the velocity was found to vary inversely with the square of the aperture diameter. The results of the heat exchange studies indicate that a decrease in heat loss leads to a considerable increase in the propagation velocity of the shock discontinuity. It may be concluded that flame propagation can be controlled by determining suitable conditions of external friction. R.C.M.

N63-12273 Academy of Sciences (USSR). G. M. Krzhizhanovsky Inst. of Power Engineering, Moscow

LAWS DESCRIBING FORMATION OF A FLAME FRONT IN A FREE JET

L. N. Khitrin, S. A. Gol'denberg, and I. N. Sundukov *In* Israel Program for Scientific Translations, Ltd., Jerusalem Gas Dynamics and Physics of Combustion 1962 p 104-111 2 refs (See N63-12262 05-11) OTS: $1.75

The combustion process in a free jet is analyzed to establish the laws describing the formation of the flame front. Equations are derived for determining the distributions of velocity and temperature in the jet flame and compared to existing data for both central and peripheral ignition. The experimental results for flame propagation velocity (u_1 = 1.2 m/sec) showed satisfactory agreement with the theoretical results (u_1 = 1.1 m/sec). R.C.M.

N63-12274 Academy of Sciences (USSR). G. M. Krzhizhanovsky Inst. of Power Engineering, Moscow

INVESTIGATION OF THE COMBUSTION BEHIND A FLAME FRONT IN A TURBULENT STREAM

S. A. Gol'denberg, I. N. Sundukov, and V. S. Pelevin *In* Israel Program for Scientific Translations, Ltd., Jerusalem Gas Dynamics and Physics of Combustion 1962 p 112-138 11 refs (See N63-12262 05-11) OTS: $1.75

The combustion process behind a flame front is studied to extend the data obtained by Ubbelohde and Anwander for laminar flow to the case for turbulent flow. The combustion products are analyzed at points ranging from 150-mm to 1400-mm after ignition of a benzine-air mixture flowing at velocities between 32 m/sec and 78 m/sec. The completeness of combustion was determined and related to the air-excess coefficient, the temperature, and the heat loss. The heat liberation was found to be 104 x 10^4 kcal/m^3 hour for a completeness of combustion of 96%. Formulas for determining the effective burning-rate constant and the length of the combustion zone are developed. These experiments show that under conditions of turbulent flow, about 25% of the initial amount of fuel undergoes afterburning behind the flame front. R.C.M.

N63-12275 Academy of Sciences (USSR). G. M. Krzhizhanovsky Inst. of Power Engineering, Moscow

THE PROPAGATION OF A TURBULENT FLAME FRONT IN THE PRESENCE OF HIGH FLOW VELOCITIES

L. N. Khitrin and S. A. Gol'denberg *In* Israel Program for Scientific Translations, Ltd., Jerusalem Gas Dynamics and Physics of Combustion 1962 p 139-168 14 refs (See N63-12262 05-11) OTS: $1.75

Jet-flame combustion in a turbulent stream of a benzine-air mixture was investigated to determine the criteria for combustion stability and flame front propagation velocity. The study was made using free jets of vapor-air mixture discharged from pipes of diameter ranging from 16-mm to 141-mm. In the presence of a continuously acting igniter, which is independent of the main flow, ignition was stable and occurred without periodic flashes or sharp oscillations. The propagation velocity of the turbulent front was found to vary linearly with the flow velocity and to be independent of the pipe diameter. The velocity was also found to be dependent on the chemical properties of fuel. R.C.M.

N63-12280 Warner & Swasey Co. Control Instrument Div., N.Y.

INFRARED RADIATION AND TEMPERATURE MEASUREMENTS IN SOLID PROPELLANT FLAMES. I. PRELIMINARY STUDY OF ARCITE 368

Gunter J. Penzias, Eliot T. Liang, and Richard H. Tourin Oct. 1962 36 p 8 refs

(Contracts Nonr-3657(00) and ARPA Order 237-62; Proj. DEFENDER) (TR-800-5)

Infrared radiation and temperature measurements have been made of combustion gases evolved in the burning of Arcite 368, a composite-type solid propellant. A combustion system and instrumentation were constructed which permitted measurements to be made under controlled conditions. The spectral radiance, emissivity, and temperature of the solid propellant flame were measured in the 1.0μ to 5.0μ region, at several distances from the burning surface. The chemical species observed were HCl, CO_2 and H_2O. These results can be used to predict radiation of larger flames. Flame temperature increased with the distance from the burning surface, reaching a maximum equal to the adiabatic temperature at 0.8 mm. The indicated reaction-zone thickness is in agreement with measurements made by photographic techniques. Author

27 PROPULSION

Includes: airbreathing, electric, liquid, nuclear, and solid propulsion.

For related information see: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N63-11964 Defense Metals Information Center, Battelle Memorial Inst., Columbus, Ohio

DESIGN CONSIDERATIONS IN SELECTING MATERIALS FOR LARGE SOLID-PROPELLANT ROCKET-MOTOR CASES

C. W. Bert and W. S. Hyler Dec. 10, 1962 73 p 54 refs

(Contract AF 33(616)-7747) (DMIC-180)

This report covers the selection of materials, from the standpoint of design, for the inert parts of large solid-propellant rocket-motor cases. The main intent is to clarify considerations of design for the benefit of materials specialists in the aerospace industry, and for the benefit of the materials industries which supply the aerospace industry. A brief description is presented of types of missions and mission profiles together with a discussion of the loads and environment to which the missile is subjected. Since mechanical and thermal loads are reacted by the motor case acting as a structure, a discussion of stresses and other design factors is included. Structural reliability, static and fatigue behavior, environmental effects, and structural weight are discussed from a design point of view. Author

N63-11988 Pratt and Whitney Aircraft, East Hartford, Conn.

RESEARCH AND DEVELOPMENT OF TITANIUM ROCKET MOTOR CASE Ninth Quarterly Technical Report [July 1 September 30, 1962]

W. E. Helfrich and H. A. Hauser Oct. 31, 1962 77 p

(Contract DA-19-020-ORD-5230) (PWA-2106; WAL-TR-766.2/1-8)

The results of work on the research and development of a high-strength, lightweight titanium-alloy rocket case are reported. These

results include (1) smooth tensile properties (70° F) of a subscale 14-inch diameter flow-turned cylinder, vacuum-annealed at 1400° F and re-solution-treated at 1800° F prior to flow-turning, (2) cyclic loading-test results on TIG-welded B-120 VCA titanium alloy and AISI H-11 steel, (3) tensile properties (70° F) of full-scale 40-inch diameter front and rear domes press-forged in closed dies at 1750° F, and (4) tensile properties (70° F) of a subscale 14-inch diameter cylinder re-solution-treated at 1800° F prior to flow-turning. Author

N63-12205 Frankford Arsenal. Pitman-Dunn Labs., Philadelphia, Pa.
PROPELLANT ACTUATED DEVICES Monthly Progress Report No. 83
Oct. 1962 43 p
The work covered includes the design and development of specific devices, such as thrusters, catapults, and initiators; investigations of related subjects, such as propellants and structural materials; and feasibility studies, aimed at improving the performance of propellant actuated devices and extending their application. B.J.C.

N63-12211 Atomic Energy Commission. Div. of Reactor Development, Washington, D. C.
ADVANCED NUCLEAR ROCKET MATERIALS RESEARCH
May 31, 1962 8 p
(TID-16315 (Del.)) OTS: $0.50
The state-of-the-art of advanced nuclear-rocket materials research includes discussions on: metals, graphite, carbides, sulfides, nitrides, oxides, and borides. I.v.L.

N63-12222 Aerospace Corp., El Segundo, Calif.
FLIGHT VEHICLE POWER AND MATERIALS Applied Research Programs Abstract Bulletin, Volume II (Part I), Abstracts 2-1 through 2-81
K. B. Andrews, N. B. Crow, M. S. Hicks, E. Moore, E. H. Smith, and K. N. Trirogoff July 1962 70 p 81 refs
(Contract AF 04(647)-930)
(TDR-930(2701-01)TN-1, Vol. II, Part I, No. 1; DCAS-TN-61-3, Vol. II, Part 1, No. 1)
This bulletin contains abstracts of the unclassified literature on the subject of Flight Vehicle Power (USAF Applied Research Area 750F). Abstracts of selected references in the field of materials are also included. All abstracts are prepared from the original reports and are limited to those available within Aerospace Corporation. Author

N63-12242 Garrett Corp. AiResearch Mfg. Div., Phoenix, Ariz.
GEM PROPULSION SYSTEM STUDY Progress Report [Nov. 30, 1961-Nov. 30, 1962]
Y. Senoo Dec. 7, 1962 86 p 4 refs
(Contract NONr-3024)
(AP-5062-R)
The design of the air-moving system of a ground effects machine was investigated to determine which combination of duct and fan parameters gave the highest efficiency. Based on these analyses, a typical radial-fan and vaned-duct delivery system was designed and fabricated to scale, and a novel T-fan design was also developed. Tests of the T-fan demonstrated a maximum efficiency of 83%. At a large flow rate, however, the shroud section of the T-fan stalled. Further investigations are being conducted to determine the cause of the stall. M.P.G.

N63-12302 Massachusetts Inst. of Tech., Cambridge
MAGNETOHYDRODYNAMIC POWER GENERATION—ITS PRINCIPLES AND PROBLEMS
W. Craig Moffatt Charlottesville, Virginia U. School of Eng. and Applied Sci., Jan. 1963 29 p 13 refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(MIT-29-P)
The increasing reliance on thermal plants for the production of electrical power has prompted a growing interest in unconventional power generation techniques. One of the most promising of these, and one which is the focus of a considerable research and development effort, is magnetohydrodynamics. This scheme envisions the generation of power by passing an electrically conducting fluid, usually a high temperature gas, through transverse electric and magnetic fields. In its simplest form, this type of machine is exactly analogous to the conventional generator, except that a moving fluid conductor is substituted for a rotating wire-wound armature. In this paper the basic operating principles of an MHD generator are presented, and some of the major problems yet to be overcome before such devices become practical realities are described. Typical power plant arrangements incorporating MHD channels are set forth and estimates of the relative costs of plants and power production for a number of configurations are presented. Author

N63-12324 Rocketdyne, Canoga Park, Calif.
DEVELOPMENT OF LIGHTWEIGHT, SEGMENTED ROCKET MOTOR CASES EMPLOYING FIBERGLASS Third Quarterly [Documentary] Report [Oct. 1-Dec. 31, 1962]
N. F. Scudder Edwards AFB, Calif., Rocket Propulsion Labs., Jan. 28, 1963 47 p
(Contract AF 04(611)-8185)
(R-3703-3)
Technical information on a program for development of lightweight, segmented motor cases is presented. Results of axial compression tests on 10-inch-diameter cylinders of the same proportions as subscale models are presented and analyzed. The strain compatibility analysis was continued to show effects on the weight of the part of the use of materials having different elastic properties. Mechanics of making windings with the numerically controlled winding machine are discussed, and information on the process for manufacturing the metal laminae is given. Author

28 SPACE RADIATION

Includes: cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts.

For related information see: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N63-12034 Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.
THE PHYSICAL SIGNIFICANCE AND APPLICATION OF L, B_o, AND R_o TO GEOMAGNETICALLY TRAPPED PARTICLES
Edward C. Stone (NASA Fellow, 1962-63) Dec. 1962 27 p 5 refs Submitted for Publication
(NASA Grant NsG-179-61; Contract AF 49(638)-1008, and Grant AF-AFOSR-62-23)
(EFINS-62-72) OTS: $2.60 ph, $1.01 mf
The degeneracy of invariant shells in the dipole field is removed by azimuthal asymmetry in the geomagnetic field. A distinction is made, therefore, between the use of parameters as invariants of charged particle motion (invariant representation) and their use as constants for all particles on a line of force (degenerate representation). Emphasis is placed upon L as an invariant parameter and upon the near-equality of the L-value of a particle and the equatorial radius R_o of the geomagnetic line of force on which the particle is mirroring. The L-value differs for particles which are on the same line

of force but have different mirror points B_m. Thus, the exact L-values of observed particles can be calculated only if the corresponding mirror points are known. The different of L for particles on a given line is equal in first order to the radial separation of the particles as they drift in longitude. The separation is ≈1% of the shell radius and represents the accuracy with which a single L-value describes all particles on a given line. The use of B_o, the minimum B-value of the line, or R_o, the equatorial radius of the line, gives a degenerate representation of comparable accuracy with less calculation. For invariant representation, however, the accuracy of L is ultimately limited only by the accuracy of the mirror point determination.

Author

N63-12064 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SEPTEMBER 26, 1960 SOLAR COSMIC RAY EVENT

C. E. Fichtel, D. A. Kniffen, and K. W. Ogilvie Washington, NASA, Jan. 1963 9 p 17 refs Previously published in J. Geophys. Res., v. 67, no. 10, Sept. 1962 p 3669-3672
(NASA TN D-1675) OTS: $0.50

Type IV radio emission is thought to be the most important observable characteristic of solar flares producing high-energy particles. It is shown that solar cosmic-ray particles arrived at the earth on September 27, 1960, following a small flare accompanied by a type IV burst of short duration. Apart from their magnitude, the characteristics of this event do not differ essentially from those of larger events.

Author

N63-12120 Harvard Coll. Observatory, Cambridge, Mass.

[NOISE STORMS, SOLAR FLARES, AND TYPE V BURSTS] Scientific Report No. 3

Elske v. P. Smith and Patrick S. Mc Intosh Dec. 1962 15 p 18 refs Repr. from J. Geophys. Research, v. 67, no. 3, Mar. 1962 p 1013-1016, and no. 10, Sept. 1962 p 3797-3804
(Contract AF 19(604)-4961)
(AFCRL-62-1066)

CONTENTS:

1. ON THE ASSOCIATION BETWEEN NOISE STORMS AND SOLAR FLARES E. v. P. Smith and P. S. Mc Intosh p 1013-1016 9 refs
2. TYPE V BURSTS AND THEIR ASSOCIATION WITH FLARES, AND ADDENDA TO THE FLARE ASSOCIATION OF TYPE I BURSTS E. v. P. Smith p 3797-3804 9 refs

N63-12121 Harvard Coll. Observatory. Radio Astronomy Station, Fort Davis, Tex.

SPECTRAL OBSERVATIONS OF SOLAR RADIO BURSTS. III. CONTINUUM BURSTS Scientific Report No.5

A. R. Thompson and A. Maxwell Dec. 1962 25 p 41 refs Repr. from Astrophys. J. v. 136, no. 2, Sept. 1962 p 546-558
(Contract AF 19(604)-8380)
(AFCRL-62-1117)

The characteristics of continuum radio bursts from the sun, over the frequency range 25 to 70000 mc/s, are reviewed. Spectral records show the development of these bursts. They are generally complex in character but may be divided into five main categories: large bursts (type IV) generally covering many octaves and lasting from 5 minutes to several hours, at the time of important flares; background radiation to noise storms; short-lived bursts, of a few minutes' duration, following certain groups of fast-drift bursts; some bursts limited to the microwave range; one example of a continuum storm, that lasted for 4 days, occurred mainly at frequencies less than 100 mc/s and was not flare-initiated. Type IV radiation is generally continuous in both time and frequency but sometimes reveals a pulsating structure; this characteristic is described and illustrated. The properties of the bursts are discussed in terms of existing models, based on the supposition that the radiation is generated by deceleration of electrons of relativistic velocities in magnetic fields (synchrotron emission). The maximum frequency of the radiation is discussed in terms of electron energies and magnetic fields in the solar atmosphere.

Author

N63-12122 Harvard Coll. Observatory, Cambridge, Mass.

SOLAR PROMINENCE ACTIVITY, 1944-1954 Scientific Report No. 15

Donald H. Menzel and F. Shirley Jones Dec. 1962 13 p 9 refs Repr. from Roy. Astron. Soc. Can. J., v. 56, no. 5
(Contract AF 19(604)-4962)
(AFCRL-62-1062)

Solar prominences appearing on surveys made at the High Altitude Observatory, Climax, Colorado, and at the Sacramento Peak Observatory, Sunspot, New Mexico, were measured for size and position and each prominence was classified according to the Menzel-Evans (1953) scheme of classification. Prominence activity is compared to spot activity, and the distribution of the various classes is studied with respect to solar latitude. During this period 93 percent of the areas were in A-type prominences and 20 percent were in S types. The hedgerow (AN) family of prominences is much the largest class; the spicules (BNs), the smallest. The activity of all classes except the spicules was greatest near spot maximum in 1947 and lowest almost two years before spot minimum in 1954. Up to and including 1947, southern areas predominated, and northern areas thereafter. Author

N63-12150 Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

THEORY OF RECONNECTION AND ANNIHILATION OF MAGNETIC FIELDS WITH APPLICATION TO SOLAR FLARES AND INTERSTELLAR SPACE

E. T. Parker (Nat. Center for Atmospheric Res., Boulder, Colo.) [1962] 85 p 55 refs
(NASA Grant NsG-96-60)
OTS: $8.10 ph, $2.75 mf

A systematic study is presented of the known mechanisms that may contribute to the diffusion, reconnection, and annihilation of large-scale magnetic fields under astrophysical circumstances. The mechanisms discussed are Joule dissipation, ambipolar diffusion, and various forms of Sweet's mechanism. It is shown that Sweet's mechanism is much more effective in a highly compressible medium than previously known, if the merging magnetic fields are exactly antiparallel. None of the known mechanisms are sufficiently rapid to account for the solar flare from the annihilation of magnetic fields. Errors and omissions in earlier discussions of the problem are cited. Since no possible energy source other than magnetic fields is known, the question of field annihilation remains both open and pressing. The possibilities of runaway electrons and hydrodynamic instability, as means for hastening magnetic field annihilation, are considered. It is shown that there is no reason to expect runaway electrons, and no effective instability unless the fields are exactly antiparallel. The diffusion of H_I regions in interstellar space is discussed. It is shown that with ambipolar diffusion the smaller and more tenuous neutral clouds are hardly tied to the interstellar magnetic field. Even the larger denser clouds may drift across the interstellar field at ~1 km/sec, so that they are not fixed in a galactic arm for periods of more than one or two revolutions of the galaxy.

Author

N63-12179 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CERENKOV SCINTILLATION COUNTER MEASUREMENTS OF THE LIGHT, MEDIUM, AND HEAVY NUCLEI IN THE PRIMARY COSMIC RADIATION FROM SUNSPOT MINIMUM TO SUNSPOT MAXIMUM

W. R. Webber (Imperial Coll., London) and F. B. Mc Donald Repr. from J. Geophys. Research, v. 67, no. 6, June 1962 p 2119-2132 33 refs Previously processed as a preprint; see N62-12912 08-28

The intensity and rigidity spectra of Be, B, C, N, and O have been measured on a series of three Skyhook balloon flights using a Cerenkov scintillation detector combination. The flights occurred at times close to solar minimum and maximum. The energy and charge resolution is comparable to that obtained by the latest emulsion techniques. It is observed that the light and medium nuclei display the same relative rigidity spectra throughout the solar cycle as the protons and α particles. This conclusion is valid only in the region studied ($E > 400$ Mev/nucleon), and striking variations for heavy primaries of low energy may be expected. The measured ratio of light to medium nuclei at the top of the atmosphere was 0.36 ± 0.06; it was not observed to vary appreciably over the solar cycle. Author

N63-12328 Iowa State U., Iowa City
ABSOLUTE INTENSITIES OF GEOMAGNETICALLY TRAPPED PARTICLES WITH EXPLORED XIV
L. A. Frank, J. A. Van Allen, W. A. Whelpley and J. D. Craven Dec. 1962 25 p 12 refs
(NASA Grant NsG-233-62)
(SUI-62-31) OTS: $2.60 ph, $0.95 mf

Observations on the absolute intensities of geomagnetically trapped protons and electrons in the earth's outer radiation zone and on the nature of the outer boundary of the magnetosphere are reported. The equipment was carried on the NASA satellite Explorer XIV which was launched on October 2, 1962, into an eccentric orbit whose apogee was initially at 16.5 earth radii from the center of the earth on a line at 71° to the line from the center of the earth to the sun. Sample omnidirectional intensities of electrons on October 5, 1962, near the magnetic equatorial plane were: $J_o(E_e \geq 40\ Kev) = 1.5 \times 10^8\ /cm^2\ sec$; $J_o(E_e \geq 230\ Kev) \leq 1.5 \times 10^6\ /cm^2\ sec$; and $J_o(E_e \geq 1.6\ Mev) = 2 \times 10^3\ /cm^2\ sec$ at a geocentric radial distance of 39,000 km; and of electrons and protons: $J_o(E_p \geq 500\ Kev) = 4(\pm 2) \times 10^4\ /cm^2\ sec$; $J_o(E_e \geq 230\ Kev) \leq 4 \times 10^4\ /cm^2\ sec$; and $J_o(E_p \geq 4.5\ Mev) \leq 1.5 \times 10^4\ /cm^2\ sec$ at a geocentric radial distance of 20,000 km. There are large fluctuations from day to day. Author

N63-12347 Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.
PRIMARY COSMIC RAY AND SOLAR PROTONS II
Rochus Vogt (Calif. Inst. of Tech.) and Peter Meyer Dec. 1962 22 p 14 refs Submitted for Publication
(NASA Grant NsG-144-61)
(EFINS-62-57) OTS: $2.60 ph, $0.86 mf

During July and August 1961 the energy spectrum of primary cosmic ray protons was investigated in the energy range from 80 to 350 Mev. The observations were made in five high altitude balloon flights at geomagnetic latitudes $\lambda \geq 73°$ N. Solar flare and quiet day spectra were obtained. A comparison of the 1960 and 1961 results leads to the conclusions that: (1) a significant flux of low energy protons is continually present in the primary radiation in the years of high solar activity; (2) this flux decreases with the declining level of solar activity as the galactic cosmic ray flux increases. It is, therefore, suggested that it is of solar origin, and (3) the time dependence of the observed proton flux suggests the following alternatives: (a) the particles are produced or released more or less continuously by the sun and do not originate only in the large flare events; or (b) the particles are produced in individual large solar flares and subsequently stored over long periods of time. This second alternative would require a new and as yet unknown storage mechanism with a characteristic time of about 30 or more days. Author

29 SPACE SCIENCES

Includes: space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories.

For space biology see: 16 Life Sciences.

For related information see: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N63-12029 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
CALCULATION OF THE ORBITS OF ARTIFICIAL EARTH SATELLITES (VYCHISLENIE ORBIT ISKUSSTVENNYKH SPUTNIKOV ZEMLI)
S. G. Makover London, Ministry of Aviation, Nov. 1962 11 p 6 refs Transl. by J. W. T. Palmer from Byul. St. Optich. Nablyudeniya Iskusstv. Sputnikov Zemli 24 (1961) p 3-11
(RAE-Library Translation-1015)

The successful launch of the first artificial earth satellite presented celestial mechanics with a number of problems now in principle, including the creation of a theory for the motion of these celestial bodies and comparison of the theory with the observations. The solution of the two problems is the immediate objective of the work on study of the motion of artificial earth satellites. Author

N63-12030 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
INVESTIGATION OF THE MOTION OF THE SECOND SOVIET ARTIFICIAL EARTH SATELLITE (ISSLEDOVANIE DVIZHENIYA VTOROGO SOVETSKOGO ISKUSSTVENNOGO SPUTNIKA ZEMLI)
S. G. Makover, V. T. Gontkovskaya, N. G. Kotchina, A. S. Sochilina, and N. S. Subbotina London, Ministry of Aviation, Nov. 1962 7 p 1 ref Transl. by J. W. T. Palmer from Byull. St. Optich. Nablyudeniya Iskusstv. Sputnikov Zemli 24, (1961) p 11-16
(RAE-Library Translation-1016)

The present paper calculates the systems of the elements of the second artificial earth satellite which are suitable for calculating short duration Ephemerides. Author

N63-12040 RAND Corp., Santa Monica, Calif.
SOME ASPECTS OF THE SURVEY OF THE MAGNETIC FIELD OF THE MOON AND THE PLANETS
E. H. Vestine Dec. 1962 23 p 38 refs
(NASA Contract NASr-21(05))
(RM-3140-NASA) OTS: $2.60, $0.89 mf

Studies of the magnetic fields of planets and other solar-system bodies comprise a fundamental part of any systematic program of space research. The author describes a cursory and preliminary plan for magnetic surveys of other planets, discusses the magnetic instrumentation, and concludes that an impacting probe carrying presently available instruments together with one or, at most, a small number of magnetic observatories on the surface of the planet would be adequate for most scientific purposes. Then, on the basis of several theories of the origin of planetary magnetism, he estimates the steady-state magnetic fields of a number of planets and satellites. The crudely estimated planetary fields (at the surface) range from about 700 gauss for Jupiter to 0.03 gauss for Mercury; the fields estimated for natural satellites based on rock magnetism are uniformly very small, in the neighborhood of 0.0004 gauss. Transient planetary magnetic fluctuations due to solar streams of charged particles, or to solar magnetic fields transported to the planet by this solar stream,or to atmospheric electric currents may be substantially larger than the steady-state magnetic fields of the Moon and other bodies of the solar system. Author

N63-12063 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MATHEMATICAL ANALYSIS FOR THE ORIENTATION AND CONTROL OF THE ORBITING ASTRONOMICAL OBSERVATORY SATELLITE
Paul B. Davenport Washington, NASA, Jan. 1963 19 p
(NASA TN D-1668) OTS: $0.50

A mathematical model is developed by which the following satellite orientation and control problems may be resolved: (1) determining attitude for maximum area of solar cells in sunlight; (2) generating slewing commands for a change in attitude; (3) computing star-tracker gimbal angles for maintaining proper orientation; and (4) determining when guide stars are occulted by the earth, sun, and moon. Author

N63-12075 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ANALYTIC REPRESENTATION OF MUSEN'S THEORY OF ARTIFICIAL SATELLITES IN TERMS OF THE ORBITAL TRUE LONGITUDE
Ann E. Bailie and David Fisher Washington, NASA, Jan. 1963 23 p 4 refs
(NASA TN D-1468) OTS: $0.75

Analytic solutions to order k_2 of the differential equations of Musen's theory of artificial satellites are presented. These solutions include long-period terms and terms with small divisors derived from the k_2^2 approximation as well as from the third and fourth harmonics of the earth's potential. The results obtained herein may be used for computing orbits of artificial satellites to the first order, for checking the machine programing of the numerical theory, and for comparing Musen's theory with other artificial satellite theories. In addition, these results may be incorporated into the numerical theory to broaden its applicability, particularly in the case of nearly circular orbits. Author

N63-12117 Smithsonian Astrophysical Observatory, Cambridge, Mass.
ON SOME SINGULAR ORBITS OF AN EARTH-MOON SATELLITE WITH A HIGH AREA-MASS RATIO
G. Colombo and D. A. Lautman (Harvard Coll. Obs.) Nov. 9, 1962 17 p 4 refs
(NASA Grant NsG-87-60)
(SAO Special Rept.-107) OTS: $1.60 ph, $0.80 mf

The restricted three-body system is taken as a first approximation to the Earth-Moon satellite system and a ballistic trajectory is considered, with a firing point near the Earth, so that the object will become, at least temporarily, a satellite of the Moon. The general plan is as follows: a satellite is launched consisting of a payload and large balloon or sail to be deployed after the complex achieves orbit. Insertion conditions are chosen so that the combined gravitational action of the Moon and the radiation pressure of the Sun permit capture by the Moon after the satellite has made a small number of revolutions around the Earth. At an appropriate instant, the balloon or sail is separated from the payload to cut off radiation pressure and to permit the payload to remain in stable orbit around the Moon. Three basic capture orbits and two variations of the second capture orbit were calculated. A.S.

N63-12118 Smithsonian Astrophysical Observatory, Cambridge, Mass.
ON THE LIBRATION ORBITS OF A PARTICLE NEAR THE TRIANGULAR POINT IN THE SEMIRESTRICTED THREE-BODY PROBLEM
G. Colombo, D. Lautman, and C. Munford [1962] 12 p 1 ref
(NASA Grant NsG-87-60)
(SAO Special Rept.-108) OTS: $1.60 ph, $0.180 mf

This paper describes a numerical analysis of the motion of an infinitesimal body around the Lagrangian triangular point in the semirestricted three-body problem. The principal goal of the present research is the determination of the influence of the eccentricity of the moon's orbit on the small oscillation (librations) of the infinitesimal body around the triangular point. The computer program used for this analysis was written for another problem (Colombo, Lautman, 1962). Although the numerical accuracy could be greater, the results are both interesting and significant. The expected decrease in the degree of stability of the libration orbit was confirmed Author

N63-12220 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
BIOSATELLITE RECOVERY FROM CIRCULAR ORBITS
C. J. Swet Oct. 1962 46 p
(Contract NOw-62-0604-c)
(CM-1026)

Presented in nonspecialized terms are some results of a recent parametric study of a wide variety of likely descent trajectories from near-earth orbits. Although these results were computed by approximate methods, they are believed to be sufficiently accurate for most planning purposes. No attempt is made to describe the computational methods or the underlying physics. Author

N63-12341 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE PROGRAMS SUMMARY NO. 37-18, VOLUME VI FOR THE PERIOD SEPTEMBER 1, 1962 TO DECEMBER 1, 1962. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
W. H. Pickering Dec. 31, 1962 80 p 4 refs
(NASA Contract NAS7-100)
(JPL Space Programs Summary 37-18) OTS: $7.60 ph, $2.60 mf

This report includes the following discussions in space exploration programs and space sciences: (1) the lunar program, consisting of the Ranger project and the Surveyor project; (2) the planetary-interplanetary program, consisting of the Mariner project and the Voyager project; and (3) the DSIF program. D.B.

30 SPACE VEHICLES

Includes: launch vehicle—spacecraft combinations; operating problems; and stability and control.

For manned space capsules, satellites, and space probes see: 32 Space Vehicles (Spacecraft).

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For related information see: 04 Aircraft; 08 Communication; and 22 Navigation and Guidance.

N63-11986 National Aeronautics and Space Admininstration. Langley Research Center, Langley Station, Va.
ENVIRONMENTAL PROBLEMS OF SPACE FLIGHT STRUCTURES. II. METEOROID HAZARD
John R. Davidson and Paul E. Sandorff Washington, NASA, Jan. 1963 75 p 102 refs Prepared in collaboration with the NASA Research Advisory Comm. on Missile and Space Vehicle Structures For Part I., "Ionizing Radiation in Space and its Influence on Spacecraft Design", see N62-16103 16-28
(NASA TN D-1493) OTS: $2.00

The meteoroid environment and the effects of hypervelocity impact on space vehicles are described, and the effects of the incompleteness of present knowledge of each are discussed. The overall

problem of the meteoroid hazard is evaluated and methods of eliminating the probability of meteoroid damage are given. A partial listing of typical research projects on meteoroid-environment and hypervelocity-impact problems is presented. Author

N63-12072 National Aeronautics and Space Administration, Washington, D. C.
PROJECT RELAY
Washington, GPO, Jan. 14, 1963 3 p
(NASA FACTS-G-12-62) GPO: $0.15

This fact sheet describes NASA's Relay satellite program, including the following areas: ground facilities, global communications services, microwave communications, Relay satellite components, Relay experiments, and launch and orbital information. R.C.M.

N63-12073 National Aeronautics and Space Administration, Washington, D. C.
THE EXPLORER SATELLITES
Washington, GPO, 1962 1 p
(NASA FACTS-E-10-62) GPO: $0.15

The Explorer satellites are described with respect to structure, launching, instrumentation, orbit, purpose, and accomplishments. Photographs, diagrams, and artists conceptions are presented of the satellites, the Delta launch vehicle, the satellite orbit, and phenomena such as the Van Allen belts, which are passed through during flights. A.S.

N63-12195 National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
FEASIBILITY OF APPLYING FIELD-ION EMISSION TO ELECTROSTATIC ROCKET ENGINES
N. Stankiewicz Washington, NASA, Jan. 1963 22 p 8 refs
(NASA TN D-1563) OTS: $0.75

The W.K.B. method was used to determine the ionization lifetimes of hydrogen, lithium, sodium, rubidium, cesium, and xenon in an applied electric field. These lifetimes were used in the analysis of a theoretical plane-diode engine consisting of a grid emitter that field-ionizes the impinging propellant. Results show that monatomic gaseous propellants are not suitable for field-ion emission engines of this design because of the excessively high voltage requirements for ionization. Author

N63-12246 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF THE LATERAL VIBRATION CHARACTERISTICS OF A 1/5-SCALE MODEL OF SATURN SA-1
John S. Mixson, John J. Catherine, and Ali Arman Washington, NASA, Jan. 1963 66 p 4 refs
(NASA TN D-1593) OTS: $1.75

Resonant frequencies and associated mode shapes, and damping of the model were determined at weight conditions simulating five points in the launch trajectory of the full-scale vehicle. The model was supported in a vertical position by a two-cable suspension system to simulate the free-free condition. The results show the unusual frequency spectrum and mode shapes associated with the clustered configuration of the Saturn SA-1 launch vehicle. In some modes, the booster tank deflections at a particular station are all approximately the same; these modes are similar to more conventional bending modes. In other modes, however, the booster outer tanks deflect in the opposite direction from the center tank; these unusual modes are termed cluster modes. Author

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes: boosters; clustered rockets; and multistage rockets.

For propulsion engines see: 27 Propulsion.

For launch vehicle - spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

No abstracts in this issue.

32 SPACE VEHICLES (SPACECRAFT)

Includes: manned space capsules; satellites; and space probes.

For boosters and rockets see: 31 Space Vehicles (Launch Vehicles).

For Launch vehicle—spacecraft combinations see: 30 Space Vehicles.

For related information see: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N63-11963 National Aeronautics and Space Administration, Washington, D. C.
ALOUETTE—CANADA'S FIRST SATELLITE
Washington, GPO, 1962 1 p

Alouette, Canada's first satellite, was launched in September 1962. The satellite is 42 inches in diameter, 34 inches high, and weighs 320 pounds. Alouette has opened new vistas in ionospheric research by extending radio-echo sounding techniques to a platform in space. Covering most of the earth, the satellite is sending radio signals downward and reporting results. Alouette sounds the ionosphere by "sweeping" radio frequencies across it. By bouncing approximately 700 different frequencies between 1.6 and 11.5 megacycles from the ionosphere, Alouette measures precisely, and in detail, electron densities at various altitudes over almost the entire globe. The satellite also gauges the intensities of high-energy radiation in space, including naturally produced cosmic rays and artificial radiation created by nuclear detonations. D.B.

N63-11990 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
RESULTS OF THE THIRD UNITED STATES MANNED ORBITAL SPACE FLIGHT, OCTOBER 3, 1962
Washington, NASA, Dec. 1962 122 p 13 refs
(Proj. Mercury)
(NASA SP-12) GPO: $0.70

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2. MISSION OPERATIONS J. D. Hodge, E. F. Kranz, and J. Stonesifer p 13-23 2 refs (See N63-11992 05-32)
3. AEROMEDICAL ANALYSIS C. A. Berry, H. A. Minners, E. P. Mc Cutcheon, and R. A. Pollard p 23-36 9 refs (See N63-11993 05-32)
4. PILOT PERFORMANCE R. E. Day and J. J. Van Bockel p 37-47 (See N63-11994 05-32)
5. PILOT'S FLIGHT REPORT W. M. Schirra, Jr. p 49-55 (See N63-11995 05-32)

N63-11991 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

SPACECRAFT AND LAUNCH-VEHICLE PERFORMANCE

John H. Boynton and Lewis R. Fisher *In its* Results of the Third United States Manned Orbital Space Flight, Oct. 3, 1962 p 1-11 2 refs (See N63-11990 05-32)

The Mercury spacecraft and the Atlas launch vehicle used in the orbital flight of Astronaut Walter M. Schirra, Jr., performed extremely well in every respect. The third United States manned orbital flight marked another key milestone in the Mercury program, in that the period of observation in space for both the astronaut and the spacecraft systems was twice that of previous missions. The only anomaly which caused concern during the flight was an elevated suit temperature experienced in the first 2 hours after launch. This condition was later found to have resulted from a foreign substance in the control valve, but the flight-control task was further aggravated by a difference between the suit-inlet temperature readings telemetered to the ground stations and those indicated to the astronaut by the instrument panel gages. However, the elevated temperature condition was adequately remedied through effective system monitoring and methodical control-valve manipulation by the astronaut. The scientific experiments included in the mission provided valuable information regarding physiographic features of the earth, the selection of filters for weather photography, nuclear radiation in terrestrial space, and the effectiveness of advanced ablation materials during an orbital reentry. Author

N63-11992 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

MISSION OPERATIONS

John D. Hodge, Eugene F. Kranz, and John Stonesifer *In its* Results of the Third United States Manned Orbital Space Flight, Oct. 3, 1962 p 13-23 2 refs (See N63-11990 05-32)

A discussion of the detailed operational support provided during the MA-8 mission, including the prelaunch, launch, orbital, and recovery phases, is presented. Because the prelaunch preparation and the launch countdown for the spacecraft and launch vehicle were nearly identical to that performed for the first two U.S. manned orbital missions, these activities are given only minor emphasis. The launch phase proceeded almost perfectly, except for a brief hold of 15 minutes' duration for repairs to the Canary Islands radar. The powered flight phase was normal, and the spacecraft was inserted into a nominal orbit. The flight was satisfactorily monitored by personnel located at ground stations around the Mercury network, and their activities are presented chronologically. The only flight discrepancy which caused concern was a suitcooling problem during the first orbital pass. The astronaut corrected this problem by gradually increasing the flow of coolant water to the suit heat exchanger. The astronaut's management of the onboard systems was excellent. He used the automatic stabilization and control system to perform successfully the retrofire and reentry maneuvers. Initial computations using flight data at retrofire indicated that the landing point would be very close to the recovery aircraft carrier, the U.S.S. *Kearsarge*. The spacecraft was observed visually during descent on the main parachute and, after landing about 4 nautical miles from the carrier, was placed aboard ship in approximately 40 minutes. Author

N63-11994 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

PILOT PERFORMANCE

Richard E. Day and John J. Van Bockel *In its* Results of the Third United States Manned Orbital Space Flight, Oct. 3, 1962 p 37-47 (See N63-11990 05-32)

The results of the MA-8 orbital flight of Astronaut Walter M. Schirra, Jr., further verify that man can function effectively in a space environment, in this instance for a period of up to 9 hours. The pilot was able to position the spacecraft to a given attitude and to complete attitude maneuvers, with a high degree of accuracy and a minimum amount of controlsystem fuel, by using only visual references as seen through the spacecraft window. This flight provided additional evidence that man can perform primary control tasks and serve as an effective backup to the automatic control modes provided. During the MA-8 mission, the pilot also demonstrated that he can efficiently perform the role of an engineering test pilot while orbiting in a space environment, if the pilot devotes his primary attention to the management of spacecraft systems and the operational aspects of the mission. Author

N63-11995 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

PILOT'S FLIGHT REPORT

Walter M. Schirra, Jr. *In its* Results of the Third United States Manned Orbital Space Flight, Oct. 3, 1962 p 49-55 (See N63-11990 05-32)

A personal narrative is presented by Astronaut Schirra of his flight experiences during the MA-8 mission. In many instances, his observations are coincident with those of the astronauts for the two previous orbital missions. However, two notable differences should be mentioned. Astronaut Schirra observed a hazelike layer that was different in both character and size from that described by Astronauts Glenn and Carpenter, and, although both of these pilots spoke of the expended sustainer stage of the launch vehicle as silvery in appearance, Schirra described it as having appeared black. The pilot witnessed both types of space particles which had been observed by Glenn and Carpenter. After reviewing the details of the turnaround maneuver, the pilot discusses the possibility of rendezvous with the launch vehicle immediately after separation from it. Despite the fact that the MA-8 orbital phase was twice the length of the previous Mercury flight, Astronaut Schirra easily adapted to the space environment and suffered no ill effects from the long periods of attitude-free drifting flight. The astronaut's candid evaluation of the systems' performance throughout the flight is a reflection of the greater emphasis placed on the engineering aspects, and was extremely valuable in making the postlaunch investigation of the flight results a comprehensive one. Author

N63-12053 National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PRELIMINARY EXPLORER 12 DATA ON PROTONS BELOW 20 kev

Michael Bader Repr. from J. Geophys. Research, v. 67, no. 13, Dec. 1962 p 5007-5011 5 refs Previously processed as preprint. For abstract see N62-12807 08-12

N63-12062 National Aeronautics and Space Administration, Washington, D. C.

DIRECT MEASUREMENTS OF COSMIC DUST SHOWERS

W. M. Alexander, O. E. Berg (NASA Goddard Space Flight Center), and M. Dubin Jan. 1963 12 p 14 refs Presented at the Symposium on the Astronomy and Physics of Meteors, Smithsonian Astrophysical Observatory, Cambridge, Mass., Aug. 28 - Sept. 1, 1961

(NASA TN D-1544) OTS: $0.50

The Explorer I interplanetary dust stream was detected for about a 10-hour period beginning on February 2, 1958. The peak impact rate was nearly 50 times the average rate over the remainder of the 12-day period of the experiment. From the limited data it may be shown that this stream was nearly in the ecliptic in a direct heliocentric orbit. This shower does not correspond to a known annually recurring meteor shower. A second stream of interplanetary dust has been detected with satellites and a sounding rocket. This stream appears to recur annually with a peak intensity on November 17. It was first detected in 1955 from the Aerobee rocket and was recognized in the November 1959 data from the Vanguard III satellite. Preliminary analysis of the Explorer VIII data indicates that it probably was also detected in 1960. The dust-stream characteristics correspond to those of the Leonids which have a heliocentric velocity of 72 km/sec. The data supporting the detection of these two interplanetary dust

streams are presented and discussed, and the physical significance of these measurements reviewed. Although direct measurements from satellites have been made over a period of about 4 months and during the time of other known meteor streams, only these two interplanetary dust streams have been detected thus far by direct measurements. Author

N63-12082 California Inst. of Tech., Pasadena
INTERPLANETARY MAGNETIC FIELDS: PRELIMINARY MARINER II OBSERVATIONS
Leverett Davis, Jr., P. J. Coleman, Jr. (California U., Los Angeles), E. J. Smith (JPL), and C. P. Sonett (NASA. Ames Res. Center) 9 p 8 refs Submitted for Publication
(NASA Grant NsG-151-61)
OTS: $1.10 ph, $0.80 mf

Results of a preliminary analysis of Mariner II magnetometer data are described. A persistent interplanetary field varying between at least 2 and 10 gamma was observed. The interplanetary field appears to lie mainly in the ecliptic plane, although there is a substantial, fluctuating, transverse component. The Mariner II data agree reasonably well with the prior Pioneer V observations. Typically, variations as large as 5 to 10 gamma in the field component radial from the sun are measured. Correlations with the Mariner II plasma measurements have been observed. Author

N63-12091 National Aeronautics and Space Administration, Washington, D. C.
MARINER
Washington, GPO, 1962 8 p
(NASA FACTS-D-62) GPO: $0.15

The Mariner spacecraft and its flight past Venus are described in language for the layman in this NASA Educational Service Publication. The Mariner's path to Venus and the midcourse maneuver are described and illustrated. Instruments carried are enumerated and the purpose of each is explained. A description and artist's conception of the Advanced Mariners for launches towards Mars and Venus in 1964 are included. A.S.

N63-12125 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE NIMBUS SPACECRAFT AND ITS COMMUNICATION SYSTEM AS OF SEPTEMBER 1961
Rudolf A. Stampfl Washington, NASA, Jan. 1963 53 p 10 refs
(NASA TN D-1422) OTS: $1.50

The major objective of the Nimbus project is to provide a capability for continuous satellite weather observation for application to weather analyses and forecasting. The spacecraft and associated ground systems have been designed to meet this objective and are now under construction. The basic measurements to be obtained include global television picture coverage of daytime cloud cover and measurements of infrared and reflected radiation, and the earth's heat balance. This paper describes the fundamental design criteria, and conditions governing this design. The characteristics of the Nimbus vehicle and its major systems are discussed and their performance is defined. Author

N63-12149 General Electric Co. Defense Systems Dept., Santa Barbara, Calif.
COMPENDIUM OF STUDIES AND REPORTS RELATING TO: LUNAR INVESTIGATIONS—ASTRODYNAMICS—SPACE VEHICLE RECOVERY
May 1962 14 p 23 refs

Available information on lunar investigation, astrodynamics, and space vehicle recovery is summarized. Reports on manned and unmanned lunar exploration include analyses of environment, systems, vehicles, communications, power supplies, survey and navigation, and earth-based equipment. Astrodynamic reports include the derivation of expressions for the effect of terrestrial harmonics on satellite orbits, and orbit prediction theory. Space vehicle recovery studies include evaluation of criteria for site selection and establishment of an order of site preference based on security, safety, terrain, climate, facilities, equipment, search problems and aids, and control center availability. M.P.G.

N63-12252 National Aeronautics and Space Administration. Marshall Space Flight, Center, Huntsville, Ala.
JUNO II SUMMARY PROJECT REPORT. VOLUME II. THE S-46 SATELLITE
Arthur W. Thompson Washington, NASA, Dec. 1962 305 p refs
(NASA TN D-608)

This volume covers those phases of the Juno II program dealing with initiation, planning, design, and construction of the S-46 payload and the unsuccessful attempt to place it in orbit about the earth. Subjects covered include the objectives of the S-46 project, system parameters, special considerations for the launching, structure of the flight unit, performance of the booster and upper stages during and after the firing, and the tracking operations. Design and construction of the S-46 mechanical system, transmitter, telemetry, electrical networks, and battery and solar cell power system are covered. The thermal design is also treated. One chapter is devoted to testing of components, modules, assemblies, prototype payloads, and actual flight units; applicable test procedures and specifications are included. The last chapter covers the State University of Iowa radiation experiment in the areas of history, instrumentation, apparatus fabrication, instrument calibration, apparatus operation during flight, and the results of the flight. Author

33 STRESSES AND LOADS

Includes: fatigue; vibration; flutter; and structural tests.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 34 Structural Design.

N63-12004 National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL PANEL FLUTTER RESULTS FOR SOME FLAT AND CURVED TITANIUM SKIN PANELS AT SUPERSONIC SPEEDS
John G. Presnell, Jr., and R. L. McKinney Washington, NASA, Jan. 1963 17 p 2 refs
(NASA TN D-1600) OTS: $0.50

The results of tests at Mach numbers from 1.72 to 2.62 on panels having a thickness from 0.015 to 0.045 inch, length-width ratio from 0.36 to 2.76, and radius-thickness ratio from 600 to infinity are presented. These results indicate a strong influence of differential pressure, which caused buckling, on the flutter mode and on the dynamic pressure at flutter for the curved panels. Results for both the flat and curved panels fall within an extrapolation of an existing experimental panel-flutter boundary. Author

N63-12005 General Electric Co. Valley Forge Space Technology Center, King of Prussia, Pa.
SOLUTION OF VISCO-PLASTIC EQUATIONS FOR AXISYMMETRIC HYPERVELOCITY IMPACT Second Summary [Final] Report, 3 November 1961-2 November 1962
T. D. Riney Eglin AFB, Fla., Air Proving Ground Center, Dec. 1962 102 p 39 refs
(Contract AF 08 (635)-1713)
(APGC-TDR-62-74)

Tentative phenomenological relations are proposed for the hypervelocity impact regime. They include (a) the flow resistance coefficient (which is of fundamental importance in the viscoplastic model for high speed impact), (b) the equation of state for both compressive and rarefaction regions of the metal, and (c) a fracture criterion for high intensity tri-axial stress distributions of extremely short duration. Also, a step-by step description of a computational procedure is presented for the solution of the viscoplastic equations governing the axisymmetric hypervelocity impact situation. The procedure incorporates the above phenomenological relations which are necessary for a realistic description of the penetration and cratering processes. Finally, a brief resume is given of the considerations that were involved in developing PICWICK, an IBM 7090 computer program for carrying out the complex and lengthy computational procedure. This unique program is a basic tool in the development of a more complete theoretical understanding of the hypervelocity impact phenomenon. Author

N63-12047 Fairchild Stratos Corp. Fairchild Aircraft and Missiles Div., Hagerstown, Md.

ELASTIC DEFORMATIONS OF CONICAL SHELLS. EQUATIONS OF EQUILIBRIUM FOR LARGE ELASTIC DEFORMATIONS OF RELATIVELY THIN TRUNCATED CONICAL SHELLS

Harvey Martin Berkowitz Sept. 1962 49 p 12 refs
(FS-AMD-R62-1)

An approximate set of equations of equilibrium for conical shells are developed from the three-dimensional equations of a continuum by considering: (1) The shell is thin; (2) the physical strains are small; (3) the medium is homogeneous and elastic; (4) the various unknown and known quantities may be expressed in power series expansions of the undeformed thickness coordinate ($\theta = z$); (5) the twisting and curving of a thickness fiber of the medium is small, so that nonlinearities enter through translations and rotations of the shell middle surface only; (6) the displacements, stresses and strains may be approximated by various truncations of the respective power series which are assumed valid and satisfy the assumed conditions on the shell surfaces; and (7) the equations of equilibrium arise from similar truncation of the exact equations consistent with the above considerations. I.v.L.

N63-12112 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

STRAIN MEASUREMENTS ON Al-Cu-Mg ALLOY FLAT PLATES FITTED WITH INTERFERENCE (SHRINK-FIT) STEEL BUSHES, UNDER STATIC TENSILE LOADS (VERFORMUNGSMESSUNGEN AN GELOCHTEN FLACHSTAEBEN AUS EINER AlCuMg-LEGIERUNG MIT IN DIE BOHRUNG EINGESCHRUMFTEN STAHLRINGEN UNTER RUHENDER ZUGBELASTUNG)

F. Bollenrath, A. von Stubbendorff, and A. Troost London, Ministry of Aviation, June 1962 6 p 7 refs Transl. by M. Squires from Z. Flugwiss. (Brunswick, W. Germany), 9(1961) 8 p 253-255
(RAE Library Translation-996)

Flat bars of an AlCuMg alloy with shrink-fit steel bushes were loaded in tension; the resulting strains were measured. The calculated stresses and stress concentration factors are compared with theoretical values. The relationship between the stress concentration factor and the degree of interference fit is presented. Author

N63-12158 Pennsylvania State U. Coll. of Engineering and Architecture, University Park

CONTINUUM MECHANICAL BEHAVIOR OF ENGINEERING MATERIALS

Joseph Marin Sept. 1962 52 p 46 refs Presented at Research Conf. on Structure and Properties of Engineering Materials, North Carolina State Coll., Raleigh, Mar. 1962
(Its Eng. Bull. B-84)

This paper reviews some of the recent developments in evaluating continuum properties, and new theories for expressing the stress-strain behavior of engineering materials under various environments. It does not pretend to cover the entire field, but the essential information on mechanical properties is briefly discussed to provide continuity of treatment. An attempt is made also to outline some experimental and theoretical areas of material science in which further research is needed for a more complete understanding of macroscopic stress-strain behavior. In other words, past, present, and possible future methods of evaluating continuum stress-strain properties are considered. In these evaluations, theories for predicting stress-strain relations for combined states of stress from uniaxial stress-strain relations are summarized. For this reason the discussion is divided into two parts, the first dealing with uniaxial stress properties and stress-strain relations, the second with combined stress properties and stress-strain relations. Author

N63-12182 Texas U. Structural Mechanics Lab., Austin

EFFECTS OF SHAPE OF LOAD PULSE ON SHOCK-MITIGATING CHARACTERISTICS OF VERMICULITE CONCRETE AND A POLYURETHANE PLASTIC

Ervin S. Perry, Eugene F. Smith, Ned Burns, and J. Neils Thompson July 13, 1962 85 p 5 refs
(Contract DA 49-146-XZ-028)
(DASA-1299)

Preliminary indications of the effects of load pulse on the shock-mitigating characteristics of lightweight vermiculite concrete and a polyurethane plastic are presented. Different input load pulses were obtained in tests on these materials using three different methods of dynamic testing. In the current study, a HYGE Shock Tester was used to provide the impact energy. The form of the characteristic acceleration-time curve from this study is compared with the form of those obtained in previously reported tests using air-gun and drop-tower facilities. Stress-strain curves obtained from the three different types of tests were found, in general, to be similar in some respects. Important differences were noted, however, and an attempt is made to explain them in terms of basic differences in the testing methods utilized. Author

N63-12184 Defense Metals Information Center, Battelle Memorial Inst., Columbus, Ohio

ELECTRON MICROSCOPIC FRACTOGRAPHY

W. R. Warke and A. R. Elsea Dec. 1962 35 p 35 refs
(Contract AF 33(616)-7747)
(DMIC Memo-161)

The areas of application of electron microscopic fractography are discussed along with its principal techniques to point out possible areas for future research. A replica of the fracture is made by the direct carbon method or the cellulose acetate-carbon method. The replica is then observed by the electron microscope under low magnification (1500 to 10,000X). Microfractographs are shown for ductile, fatigue, and intergranular fractures, and the limitations of each of these applications are discussed. Future research programs in fractography should study the effects of composition, strength level, stress level, strain rate, or other material and loading variables on the three types of failure. R.C.M.

N63-12237 Midwest Research Inst. Mathematics and Physics Div., Kansas City, Mo.

RESEARCH ON THE MECHANISMS OF FATIGUE IN ULTRA SMALL SPECIMENS Quarterly Progress Report No. 6, 1 Sept. 1962-30 Nov. 1962

J. C. Grosskreutz and Peter Waldow Dec. 17, 1962 37 p 23 refs
(Contract AF 33(616)-7858)

Fatigue-induced substructure has been studied in polycrystalline aluminum (99.99 percent) cycled at constant strain amplitude. X-ray and transmission electron microscope techniques were used. At low strains (3×10^{-4}) large concentrations of dislocation loops are often formed near subgrain boundaries, and the average subgrain volume

is much larger than that found at higher strain amplitudes. The limiting subgrain volume was determined as a function of strain amplitude. Above $\sim 2 \times 10^{-3}$, this volume is constant at approximately 9 cubic microns. A consistent model is proposed to account for the variability of substructure with strain amplitude and crystal orientation. It is concluded that the strain concentration near a fatigue crack is always sufficient to ensure that propagation of the crack will occur in material which is strongly subdivided. Author

N63-12256 General Electric Co. Space Sciences Lab., Philadelphia, Pa.

DYNAMIC BUCKLING OF SHELL STRUCTURES SUBJECT TO LONGITUDINAL IMPACT [Final Report, May 1961 - June 1962]

A. P. Coppa and W. A. Nash (Fla. U.) Wright-Patterson AFB, Ohio, Flight Dynamics Lab., Dec. 1962 86 p 16 refs
(Contract AF 33(616)-8248)
(TIS-R62-SD77; ASD-TDR-62-774)

Investigations dealing with the buckling of thin cylindrical and conical shells subject to axial impact are described. The studies consisted of experimental and theoretical efforts directed toward obtaining a qualitative and quantitative understanding of the dynamic buckling behavior of such shells under a variety of conditions. The conditions studied include different longitudinal conditions imposed on the impacted end of the shell and internal pressurization. In addition, methods of increasing the specific energy dissipation capacity of shells subject to axial impact were studied. A number of interesting results were obtained. It was demonstrated experimentally that buckling of a cylindrical shell is initiated during the first passage of the axial compression stress wave due to the initial impact when the impact velocity is sufficiently high. Another significant experimental result obtained is that the asymmetrical (quasi-developable) form of shell buckling occurs as a result of a smooth transition from the symmetrical (ring) form of buckling in some thin cylindrical shells subjected to an axially symmetric axial impact. Analytical results were obtained on the dynamical buckling behavior of cylindrical shells subject to a constant velocity end displacement. The method utilizes the finite deflection theory and is a refinement of the procedure due to A. S. Volmir. It shows that both the upper critical stress and the number of circumferential waves increase and that the time to initiate buckling decreases with increasing velocity of impact. These trends are in agreement with the analytical results of Volmir and a phenomenological theory due to Coppa. Author

N63-12257 Oak Ridge National Lab., Tenn.

AN INVESTIGATION OF THE INSTANTANEOUS AND CREEP BUCKLING OF INITIALLY OUT-OF-ROUND TUBES SUBJECTED TO EXTERNAL PRESSURE

J. M. Corum Jan. 30, 1963 83 p 26 refs
(Contract W-7405-eng-26)
(ORNL-3299) OTS: $2.00

A method was developed for predicting the instantaneous and creep buckling characteristics of initially out-of-round tubes subjected to lateral external pressure. The critical pressure causing collapse and the deformation of a tube at the instant of impending collapse may be determined by the method. Stress distributions represented by segments of the short-time stress-strain curve for the tube material were used to determine the instantaneous buckling characteristics. For creep buckling, approximate stress distributions derived from isochronous stress-strain curves were utilized, and the resulting collapse predictions were observed to become increasingly conservative with time. The method was used to predict the instantaneous and creep buckling characteristics of a series of 8.0-in.-o.d. type 304 stainless steel tubes that were collapsed at a temperature of 1200° F. Although the number of experimental tests did not represent an adequate sample, the instantaneous collapse pressures agreed closely with the predicted values, and the time-dependent collapse test results substantiated the observation that the theoretical creep-collapse predictions become increasingly conservative with time. It was found that a small initial out-of-roundness significantly reduces the resistance of a tube to collapse. Author

N63-12339 Catholic U. of America, Washington, D.C.

THE DYNAMICS OF SOLID PROPELLANT ROCKET MOTORS Summary Report

J. H. Baltrukonis Dec. 12, 1962 12 p For presentation at the Meeting on Mechanical Behavior of Solid Propellants, Orlando, Fla.
(NASA Grant NsG-125-61)
OTS: $1.60 ph, $0.80 mf

Results of analytical and experimental problems for quantitatively evaluating the contributions of the propellant to the dynamic responses of the composite structure are presented. Analytical problems included: (1) free, transverse vibrations of an infinitely long, composite, elastic-circular cylinder; (2) conformal transformation of a region with a star-shaped boundary onto a circular or annular region; (3) axial-shear vibrations of a star-shaped bar; (4) approximate determination of eigenvalues by Lagrangian multiplier method; (5) enclosure theorems (state-of-the-art); (6) axisymmetric forced axial vibrations of a semi-infinite solid cylinder; (7) axisymmetric free axial vibrations of a finite length solid cylinder case-bonded to a rigid circular tank; (8) stress reponse at ignition of a long, case-bonded, solid propellant rocket motor; (9) inertia effects in the tensile stress relaxation test; (10) extension of the underlying theory of the Maxwell apparatus; (11) creep bending of a beam-column of a viscoelastic material governed by integral-operator type constitutive law; and (12) viscoelastic property functions. Experimental problems included: (1) measurement of the complex shear modulus; and (2) measurement of the complex bulk modulus. I.v.l.

N63-12342 General Electric Co. Space Sciences Lab., Philadelphia, Pa.

STUDY OF THE RELATIONSHIP OF PROPERTIES OF COMPOSITE MATERIALS TO PROPERTIES OF THEIR CONSTITUENTS Quarterly Progress Report No. 1

Norris F. Dow and B. Walter Rosen Nov. 30, 1962 46 p 6 refs
(NASA Contract NASw-470)
OTS: $4.60 ph, $1.58 mf

The principal results of the first phase of the investigation of composite-material behavior are presented. Elastic properties of composites consisting of cylindrical voids or inclusions in an otherwise homogeneous matrix are described. Author

34 STRUCTURAL DESIGN

Includes: structural elements; and weight analysis.

For related information see: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings and Control Surfaces; and 33 Stresses and Loads.

No abstracts in this issue.

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